

computing today

No 2

**December
78**

**Win a
Triton**

THE NEW MAGAZINE FOR SMALL SYSTEMS WITH BIG IDEAS



**Simplified I/O
Microbiography
EPROM Programmer**

Presented as a supplement to ETI.

Hop on a Nasbus to 32K of memory now

The Nascom — 1 is designed with expansion in mind. This is made possible by using the best products available. The Z80 microprocessor incorporated in the basic system is so powerful it can support 64K bytes of memory and 256 ports. To utilize this capability, we have designed the buffered 77 — way Nasbus.

With this arrangement, the way is clear for considerable expansion, starting with our new memory expansion board. It has 16 memory sockets and two EPROM sockets. Therefore, you can fill it with 4K dynamic RAM up to a maximum 8K or with 16K dynamic RAM up to a maximum of 32K. A 2K Tiny BASIC in EPROM has been developed for the board.

To go with the board, we have produced a very flexible I.O board with three PIOs each giving two, 8bit ports, plus a UART for serial interface.

As you start building up your Nascom system you will need a convenient means of storing boards. Our new, custom-designed, Vero frame

will allow for a Nascom — 1 to link through a buffer board to a 77-way Motherboard. There is then the option of eight or more expansion boards. To power this capability there is a new 8.5 amp power supply especially designed for the frame.

No other system offers so much at such a low cost. And it all starts with the basic Nascom — 1 kit which for just £197.50 offers an intelligently usable system with video and cassette interface, a full alpha-numeric keyboard and a mighty CPU chip. So if you want the best — make it a Nascom system.

**Nascom-1 Kit still only
£197.50 + VAT**



Nascom Expansion — Prices

Buffer Board Kit	£25.00
4K RAM Board	£70.00
16K RAM Board	£179.00
4K RAM (4027)	£35.00
16K RAM (4116)	£106.00
Tiny BASIC	£25.00
2.2amp Power Supply	£24.50

Prices exclude VAT



Nascom Microcomputers

92 Broad Street, Chesham, Bucks.
Tel: (02405) 75151

UK National Distributors

Barrow-in-Furness

Camera Centre

Tel: 0229-20473

Torquay

CC Electronics

Tel: 0803-22699

Egham & Manchester

Electrovalue

Tel: 07843-3603

Glenfield, Leicester

Eley Electronics

Tel: 0533-8771522

London W2

Henrys Radio

Tel: 01-723 1008

Oldham, Lancs

Lock Distribution

Tel: 061-652 0431

Chesham, Bucks

Lynx Electronics

Tel: 02405-75151

Liverpool L2

Microdigital

Tel: 051-2360 0707

New Barnet, Herts

Comp Components

Tel: 01-441 2922

Airamco Ltd.

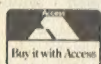
MICRO COMPUTER PRODUCTS

Distributors for JADE COMPUTER PRODUCTS
All products brand new with full industrial specification

S100 COMPUTER CARDS KIT	ASSEMBLED	BARE BOARD
Mother Board £71.00	£82.50	£26.25
Desk Top Rack, 12 slot mother board + 15A @8V, 2A @ ± 16V £199.00		
Jade 8080A CPU BOARD £75.00	£122.50	£22.50
Jade Z80 CPU BOARD 2MHz £99.95	£138.75	£26.25
Jade Z80 CPU BOARD 4MHz £112.50	£149.95	£26.25
Jade Serial/Parallel I/O BOARD £93.70	£134.29	£22.50
Jade 2708/2716 EPROM BOARD £44.95	£82.46	£22.50
(16x2708 or 2716) WITH 8 2708s £97.46	£134.96	£22.50
Jade REAL TIME CLOCK BOARD £93.71	£134.96	£22.50
Problem Solvers 16K STATIC RAM 450nS —	£270.00	—
16K STATIC RAM 250nS £296.00	£296.00	—
Jade 8K static RAM BOARD 450nS £94.50	£112.50	£19.95
Jade 8K static RAM BOARD 350nS £104.95	£119.96	£19.95
Jade 8K static RAM BOARD 250nS £127.50	£142.50	£19.95
S.D. Sales "EXPANDORAM" Dynamic Memory 375nS access time 8K £113.25	—	—
Memory 375nS access time 16K £189.00	£229.00	£189.00
Memory 375nS access time 32K £297.00	£337.00	£297.00
Memory 375nS access time 64K £513.00	£553.00	£513.00
VERSAFLOPPY DISK CONTROLLER (up to 4 drives 5 1/4" or 8") £11.75	£165.00	—
SHUGART 8" Drive —	£385.00	—
PERTEC 5 1/4" Drive —	£225.00	—

Components		
2708 1024x8 EPROM £6.99	21L02-1 450nS £1.20	
2716 2048x8 EPROM £29.90 (intel)	8 for £7.92	
2516 2048 x 8 EPROM £29.90 (equivalent of above) T.I.	21L02 250nS £1.40	
1702 256x8 EPROM £4.85	8 for £9.60	
2104 4096x1 DRAM £3.50	2112-1 256x4 (450) £2.25	
8 for £26.00	4044 4Kx1 (450) £7.45	
2107B-4 4096x1 DRAM £3.50	4045 1Kx4 (450) £8.25	
8 for £26.00	New Device MK4118 N4 (24 pin) 1k x 8 bit static RAM 250 NS. Similar pin out to 2708 EPROM. Price £16.50. Each data available.	
Note New Low Prices 16K Memory	8212 £2.49	
4115 5kM DRAM £9.99	8216 £2.75	
4116 16kx1 DRAM £14.99	8224-4 £7.46	
8 for £108.00	8226 £2.95	
6821P PIA £5.90	3881 £9.50	
AY 51013 UART £4.50	3882 £9.50	
AY51014 UART(5V) £6.50	S100 Skts. £3.30	
AY53600 ENCODER £9.99	Textool 24 pin Zero force Skt. £5.60	
8080A CPU £8.99	4115 8kx1 DRAM £9.99	
	81LS95 £1.25	
	81LS97 £1.25	

All Prices EXCLUDE VAT @ 8%.
Trade discounts on Quantity
Please add £1.00 P&P for S100 items then add VAT @ 8%.
24-hr. Ansaphone order service with ACCESS or BARCLAYCARD.
MAIL ORDER ONLY



For components please add 40p P&P, then add VAT @ 8%.
AIRAMCO LTD.
30 WITCHES LINN
ARDROSSAN
AYRSHIRE
KA22 8BR
TEL. 0294 65530
TELEX 779808 RAMCO

Semiconductor prices are always changing and the trend is generally downwards. So ring for latest up-to-date details.

computing today

No.2 December 1978

News	4	News for MPUs
PTAs Explained	6	The INS and OUTS
BASIC Explained	10	Speaking basically
Book service	15	Book Bargains
Microbiography	17	8080 under the Microscope
TRITON Competition	20	Cross-number Puzzle
EPROM Programmer	23	Blow your own
Softspot	31	Software Section

EDITORIAL ADVERTISING PRODUCTION

Halvor W. Moorshead
Ron Harris B.Sc
Gary Evans
Jim Perry
Phil Cohen B.Sc
John Koblanski
Steve Ramsahadeo
Paul Edwards
Margaret Hewitt
Andrew Scott
Kim Hamlin, Bren Goodwin
Tim Salmon, Val Tregidgo
Mark Strathern (Manager), Tom Moloney
Joy Cheshire, David Sinfield

INTRODUCTION

We do not plan a regular editorial page in Computing Today for the simple matter that we'd soon run out of things to say — try looking at the editorial pages of other magazines for ample evidence of this.

This month, however, we'd like to take this opportunity of making the familiar plea of all new magazines — please let us know what you think of us we've had a couple of interesting comments on last month's issue but we would like to think we have slightly more than ten readers with something to say if you happen to have the odd article describing some aspect of personal computing we'd also be glad to hear from you.

Last month we omitted to credit the authors of a number of items to put the record straight Howard Birkett was responsible for the NASCOM 1 review, Phil Cornes for part 1 of the BASIC explained series and Don Scales for the item on the Triton's BASIC.

Errors noted in the Triton article are: 1) On page 31 of November's ETI the keyboard connection diagram should have shown the third output down on the right-hand side of the diagram as not strobe. 2) Strictly speaking the reset signal at the extender socket is not buffered and should have been marked as such.

MICRO-COMPUTER BARGAINS

We have a stock of untested micro-computer PCB's which are surplus to our requirement. Each board contains an Intel 4040 (CPU), 4201 (Clock), 4289 (Standard Memory Interface), 5MHz crystal, zero crossover detector cct, power on reset cct, skts for 6 x 1702A PROM and on board power supply containing transformer, rectifier, regulator, heatsink and reservoir capacitor.

These PCB's are sold with data on all chips and cct diagram, as untested units at the bargain price of

£19.00 ea

Also available:

1702A memory, used but erased
..... **£6.00**

1702A memory programmed to
your requirement **£7.50**

6265 gen purpose i/p-o/p device
..... **£5.00**

Cheque/Postal Order to:

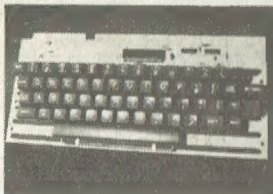
VERDURE LTD.

**54/64 Morfa Road
Strand, Swansea**

Mail Order Supplies Only

Tel: (0729) 41241/462684

HAPPY MEMORIES



ASCII KEYBOARDS £49

£1 p&p. Cursor Kit £2.50

All 128 ASCII characters, parallel output, 2 key rollover, Alpha lock, Auto-repeat, Two user-definable keys, positive and neg. strobe, All on 12½ x 6 inch PCB. Add-on five key cursor kit for up, down, left, right and home available. Send SAE for data sheet.

Science of Cambridge Mk 14. **£2.80**

Set of 18 Texas low-profile DIL sockets.

21L0s 450ns **95p**, 16 up **92p**, 64 up **89p**

21L02 250 ns **110p**, 16 up **107p**, 64 up **104p**

2114 300 ns **625p**, 4 up **600p**

4116 DRAM 1250p 4 up **1200p**

2708 450 ns **725p**, 4 up **700p**

Texas low-profile DIL sockets:

Pins 8 14 16 18 20 22 24 28 40

Pence 10 11 12 17 18 20 22 28 38

Antex 1mm bits for CX17 or CCN irons **45p**

**Happy Memories, 5 Cranbury Terrace
Southampton, Hants SO2 0LH**

All prices include VAT. Add 20p postage except where shown. COD available at cost.

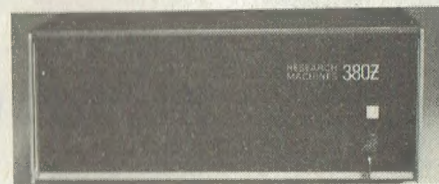
AT LOW COST

Texas Talk

We've been hearing stories about Texas's entry to the hobby/education/business computer markets for some time. Like so many other Texas product launches before it, the stories around for months before the first sight of any hardware, lead to a sense of anti-climax at the official unveiling.

Hopes that the machines will not be waiting in the wings for too much longer, however, are strengthened by the fact that Texas's European Consumer Division have just appointed a personal computer manager.

The machine should be worth the wait for it is Texas's view that a late entry into a competitive field, such as home computing, means that the product must enter on a technological cusp. What will they offer us for our money. Views vary but most seem to suggest that the Texas machine will include some form of fast access, fast transfer, form of mass storage — (floppy?, Bubble??). We say the machine is expected soon — it must be — though we were disappointed when we heard the latest pronouncement on the reason for the delay — Texas did not want to get caught up on the Christmas novelty market and so had decided to launch next year.



The research machines 380Z system has been with us for some time now Z80 based, the system in its basic form consists of a by now familiar configuration — the 380Z itself with a standard domestic TV or video monitor to provide output and a cassette recorder for back up storage.

The recent addition of a mini-floppy system to the 380Z's hardware will greatly increase the scope of the system. The mini-floppy is offered with one or two drive's each with a 70K capacity BASF drives are used and the price includes Digital Research's CP/M disc operating system, rapidly becoming the industry standard for Microcomputers.

Research Machines will be able to offer several BASIC interpreters and compilers — FORTRAN and

News

COBOL will follow. In addition, purchase of the system from Research Machines will secure membership of the CP/M user's club with access at nominal cost, to the user's club library, already running at 14 volumes.

Singleboard Superboard

Due in this country before the end of this year, the Ohio Scientific Inc Superboard 2, is a machine to look out for. The system is built on a single board — even the keyboard is on the PCB — all that is required is a 5V 3A PSU.

Based on the 6502 MPU, PET, APPLE et al, with an 8K BASIC and up to 8K of static RAM, the Superboard 2 packs quite a processing punch.

The onboard keyboard is a 53 key design providing upper and lower case plus some user programmable functions. Also included is a Kansas City tape interface.

The output is to a video monitor and the display is a 24x24 format that provides graphics as well as alpha-numeric characters.

Available options include an expander board that features 24K of static RAM, a dual mini-floppy interface and a port adapter for printer and MODEM.

The machine — can you wait? — should be available here at a cost of £284.95 — what do you say about that Commodore?

People Like Petsoft

Petsoft have arranged a reciprocal deal with Personal Software Inc, a large American Microsoftware house, with the result that PETSOFT'S large range of software will now be distributed in the States and Canada and some of Personal Software's best titles will be available from PETSOFT.

The Microchess program (£14) is one example of Personal Software's work and at the low asking price, should be well received over here.

The PETSOFT catalogue is running at about 100 titles covering everything from games to business packages and software tools. An SAE to PETSOFT at the address below will secure their catalogue. PETSOFT, P.O. BOX 9, NEWBURY, BERKSHIRE, RG13 1PB.

The exciting new
TRITON
 Personal Computer
 exclusively from:

TRANSAM

**Complete kit of
 parts available
 only £286 (+ VAT)**

Basic in Rom: a powerful 2k Tiny basic resident on board, makes Triton unique, easy to use and versatile.

Graphics: 64 Graphic characters as well as full alpha numerics.

Single Board: Holds up to 8k of memory, 4k RAM and 4k ROM, supplied with 3k ROM and 2k RAM.

Memory Mapping: 2 mode VDU, I/O or memory mapped for animated graphics.

Cassette Interface: crystal controlled Modern tape I/O with auto start/stop + "named" file search.

UHF TV Interface: On board uhf modulator, plugs into TV aerial.

Comes Complete with KEYBOARD, CASE, POWER SUPPLY, THRO-HOLE PLATED QUALITY P.C.B. FULL DOCUMENTATION POWERFUL 1k MONITOR & 2k TINY BASIC PLUS ALL COMPONENTS INCL. IC SOCKETS. NOTE TV SET & CASSETTE NOT INCLUDED.

Expansion: Fully buffered for up to 65k of memory on expansion busbar.



Building a better computer wasn't easy — but we did it.

TRANSAM

All components can be bought separately and eleven packs can be purchased on an easy-to-buy scheme. See catalogue.

The P.C.B. alone is £50 + VAT plus £1 for packing and postage.

I am interested in the Triton

Name _____

Address (please print) _____

To: TRANSAM COMPONENTS LTD.
 12 CHAPEL STREET, NW1

Please send me the following:

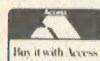
1. A copy of your latest catalogue
 I enclose 30p + S.A.E. 9" x 7
2. A copy of the Triton Manual
 I enclose £5 + 30p P & P
3. A complete kit of parts for
 Triton Computer, £286 + VAT
 + £4 P & P
4. A Printed Circuit Board
 £50 + VAT & £1 P & P

☐
☐
☐
☐

TRANSAM

TRANSAM COMPONENTS LTD.
 12 CHAPEL STREET
 LONDON, NW1 TEL: 402 8137

NEXT TO EDGWARE ROAD TUBE STATION, MET. LINE
 TRITON COMPUTER IS THE TRADE MAKE OF
 TRANSAM COMPONENTS LTD.



BARCLAYCARD, ACCESS,
 VISA & MASTER CHARGE
 ARE WELCOME. SEND
 YOUR CARD NUMBER WITH
 ORDER



ET1 9

TOTAL ENCLOSED £

Cheque, Money Order, etc.

PIAs Simplified

Ron Wilson explains the operation of a typical PIA (Peripheral Interface Adapter), clearing up the confusion often caused when a data sheet is consulted by a novice to the art of I/O. A 6800 based system is taken as an example for this article.

ON THE PIA THERE are 16 bi-directional lines that can individually be made to act as straightforward inputs or outputs. The 8 bit structure of the 6800 dictates that these lines are separated into an A group and a B group each of 8 bits. The internal register structure of the PIA is shown from the users view-point in Fig. 1. The A register group and the B register group each consist of a **Control Register**, **Data Direction Register**, and **Data Register**. It is to the data registers that the two sets of bi-directional data lines are connected. The 6800 system is organised so that the microprocessor treats the PIA registers as memory locations. The PIA can be addressed and will respond to instructions in the same way as memory.

The documentation that arrives with the ready-built microcomputer board obtained by the user will specify the PIA addresses for that system. A particular PIA might be located, for example, at addresses 8004 to 8007 inclusive. (The number system used is normally hexadecimal).

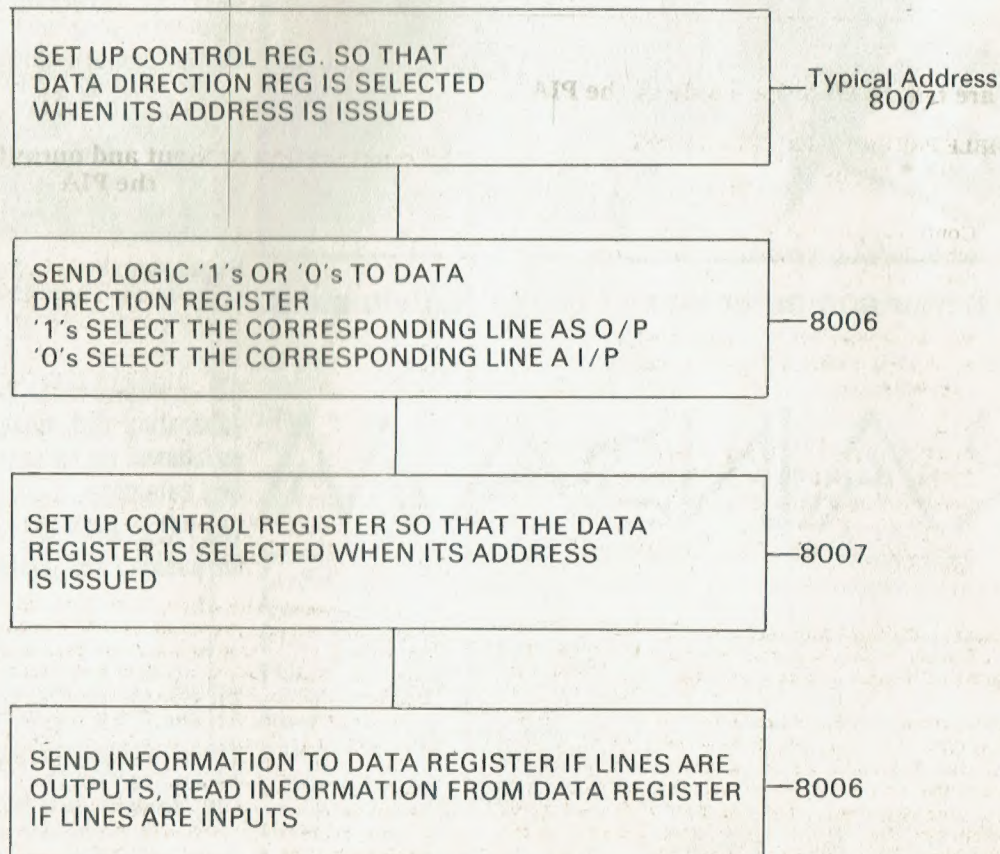
In this case the A side registers have been allocated

8004 and 8005 whereas the B side registers occupy locations 8006 and 8007. Each side has thus two addresses available to access three registers. How can three registers be accessed with only two addresses?

The address 8004 is given to two registers, the 'A' Data Direction Register and the 'A' Data Register. The required register is selected, from these two, by programming bit-two (b2) in the Control Register. The Control Register is at location 8005. When b2 is logic 0 the Data Direction Register is selected. Conversely when b2 is logic 1 the Data Register is selected. The user's aim is to configure output and input lines, so particular cases will now be illustrated.

The cases described have each been tested and work correctly. It will be shown how difficulties involved in obtaining input and output lines for direct use can be overcome. This will satisfy the initial demands of many microprocessor users. Where more complex strategies are required the interrupt and handshake facilities of the PIA may need to be incorporated.

Fig. 2. The typical procedure adopted by a user when configuring a PIA to operate in any one of its available modes.



PIAs Simplified

The Internal Registers of the PIA

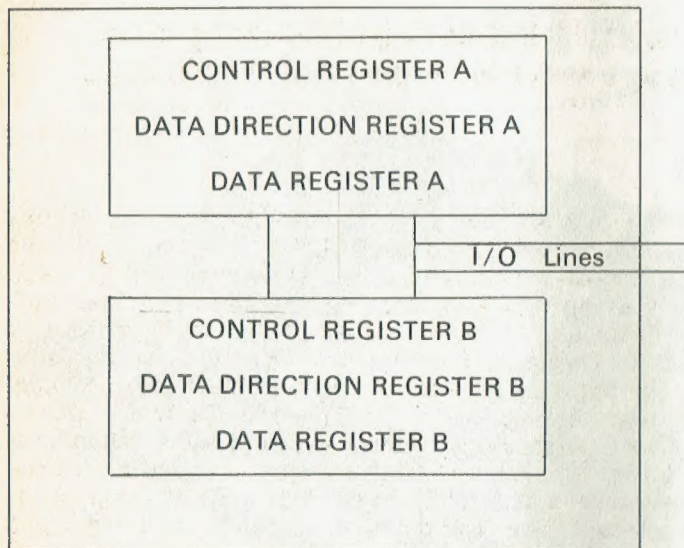


Fig. 1. The internal structure of a typical PIA. The Internal Register structure can be split into two distinct blocks each in turn consisting of a Control Register, Data Direction Register, and a Data Register. These Registers must be configured by the user to meet his requirements.

8 Output lines are needed on the B side of the PIA

POSSIBLE PREVIOUS PROGRAMMING

Code	mnemonic	Comments
86	LDA A	Load accumulator A with 0000 0000 (in binary)
00	00	
B7	STA A	Send accumulator contents to Control Register B.
80	80	As b2 = 0 the Data Direction Register B will be accessed when address 8006 is next used.
07	07	
86	LDA A	Load accumulator A with 1111 1111 (in binary)
FF	FF	
B7	STA A	Send accumulator contents to 8006. This establishes PIA B side as outputs. (A 1 configures
80	80	the corresponding line as an output.)
06	06	
86	LDA A	Load accumulator A with 000 0100
04	04	
B7	STA A	Send accumulator contents to Control Register B.
80	80	As b2 = 1, next time 8006 is addressed the Data
07	07	Register is selected
86	LDA A	Load accumulator A with 0000 1111 as typical data
0F	0F	to be output
B7	STA A	Send this data to 8006. This now acts as output information
80	80	
06	06	

This program sets up the B side of the PIA as 8 output lines then shows how to send out data along these lines. Address 8007 locates the Control Register with 8006 shared between the Data Direction Register and the Data Register.

Any data now sent from the microprocessor 8006 will act as output information. The code is the assembled version, written in hexadecimal, of the instruction mnemonic.

The sequence involved in setting up the PIA for output and / or inputs can be generalised as shown in Fig. 2.

8 Input lines are required on the A side of the PIA

POSSIBLE PREVIOUS PROGRAMMING

Code	mnemonic	Comments
86	LDA A	
00	00	Control Register A is set so that
B7	STA A	when 8004 is addressed the Data
80	80	Direction Register is selected.
05	05	
86	LDA A	
00	00	The A side of the PIA is established
B7	STA A	by setting the Data Direction Register A
80	80	to 0000 0000
04	04	
86	LDA A	
04	04	Control Register A is set so that when
B7	STA A	8004 is next addressed the Data Register
80	80	is selected and the input data read
05	05	
B6	LDA A	Load into accumulator A the input data
80	80	from 8004
04	04	

Address 8005 locates Control Register A with 8004 shared between the Data Direction Register and the Data Register. The generalised diagram of figure 2 has been used to derive this program.

The 8 lines connected to the A side act as inputs to the microprocessor system. The data on these lines can be loaded into, say, accumulator A for further processing. The use of the LDA A instruction at the end of the previous program makes use of the extended addressing mode. The location 8004 is treated as a memory location and the instruction efficiently transfers the data present on the input lines to the accumulator.

A combination of input and output lines on side A of the PIA

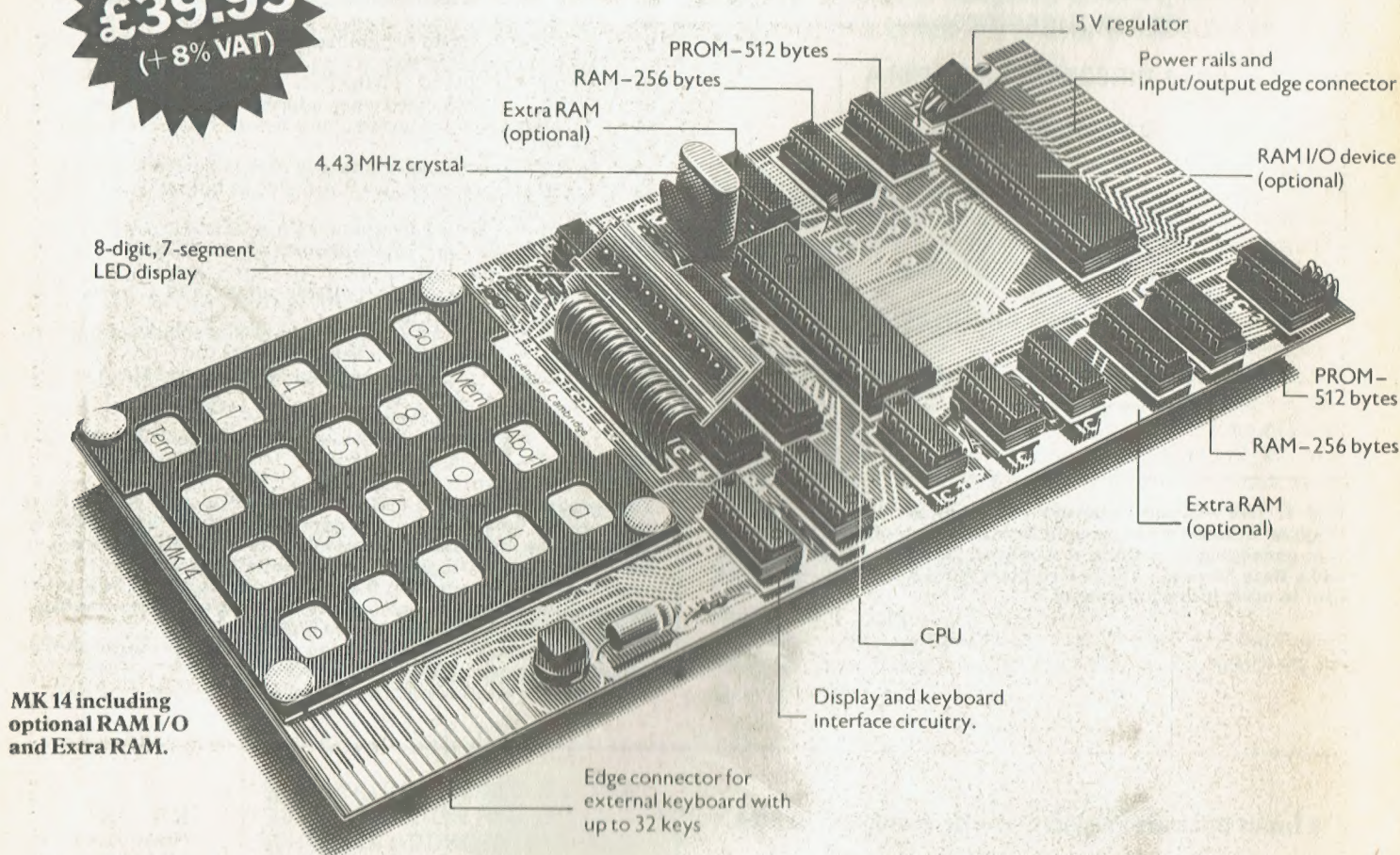
code	mnemonics	Comments
86	LDA A	
00	00	Control Register A is set so that
B7	STA A	when 8004 is addressed the Data Direction
80	80	Register is selected
05	05	
86	LDA A	The A accumulator is loaded with
E0	E0	111 00000 (in binary). This is sent to
B7	STA A	Data Direction Register A to establish
80	80	b7, b6, b5 as outputs and b4, b3, b2, b1, b0
04	04	as inputs.
96	LDA A	
04	04	Control Register A is set so that when
B7	STA A	8004 is next addressed the Data Register
80	80	is selected.
05	05	

It is a characteristic of the PIA that individual lines in an 8-bit group can be programmed to be inputs or outputs. Normally input lines are grouped together and output lines are grouped together. In the following case five input lines and three output lines are required on the A side of the PIA. The three output lines are arranged to be on lines, 5, 6 and 7 with the input lines 0 to 4. (The most significant bit position is line 7).

The input data can read into accumulator A by using LDA A in extended mode on location 8004. Data can be output from an accumulator by using STA instruction on location 8004. Only the 3 most significant bits will be effective as outputs from the accumulator data.

From Science of Cambridge: the new MK 14.

only
£39.95
(+ 8% VAT)



MK 14 including optional RAM I/O and Extra RAM.

MK 14 — a complete computer for £39.95 (+8% VAT)

The MK 14 is a complete microcomputer with a keyboard, a display, 8 x 512-byte pre-programmed PROMs, and a 256-byte RAM programmable through the keyboard.

As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard. (20 sample programs are provided in the Manual — which also contains comprehensive building instructions, and instructions on program-writing.)

Yet in kit form (which can be assembled by any fairly experienced kit-builder), the MK 14 costs only £39.95 (+£3.20 VAT, and p&p).

But that's only the start . . .

The memory capacity of the basic kit is surprisingly powerful — but every computer owner, from a schoolboy to a multi-national corporation, soon feels the need for more memory.

With the MK14, it's yours!

Optional extras include an additional 256-byte RAM, and a 16-line external input/output device (allowed for on the PCB). These give a further 128 bytes of RAM.

And the next step?

The next step is to add your own peripherals!

The first could be a low-cost module which provides an **interface with a standard cassette-recorder**. This means you can use ordinary tape-cassettes for the storage of data and programs.

To get the best from this configuration, you could uprate your system with a **revised monitor** — consisting of 2 replacement PROMs, pre-programmed with sub-routines for the interface, offset calculation and single step, and single-operation data entry.

The second peripheral could be your own **PROM programmer and blank PROMs** to set up your own pre-programmed dedicated applications. (Fusible-link device guarantees program safety.)

All are available now to owners of MK 14 — and remember Science of Cambridge keep you up to date *automatically* with advances in the MK 14 range. A TV interface device is already in the pipeline!

A valuable tool — and a training aid

As a computer, it handles operations of all types — from complex games to digital alarm clock functioning, from basic maths to a pulse delay chain. Programs are in the Manual, together with instructions for creating your own genuinely valuable programs.

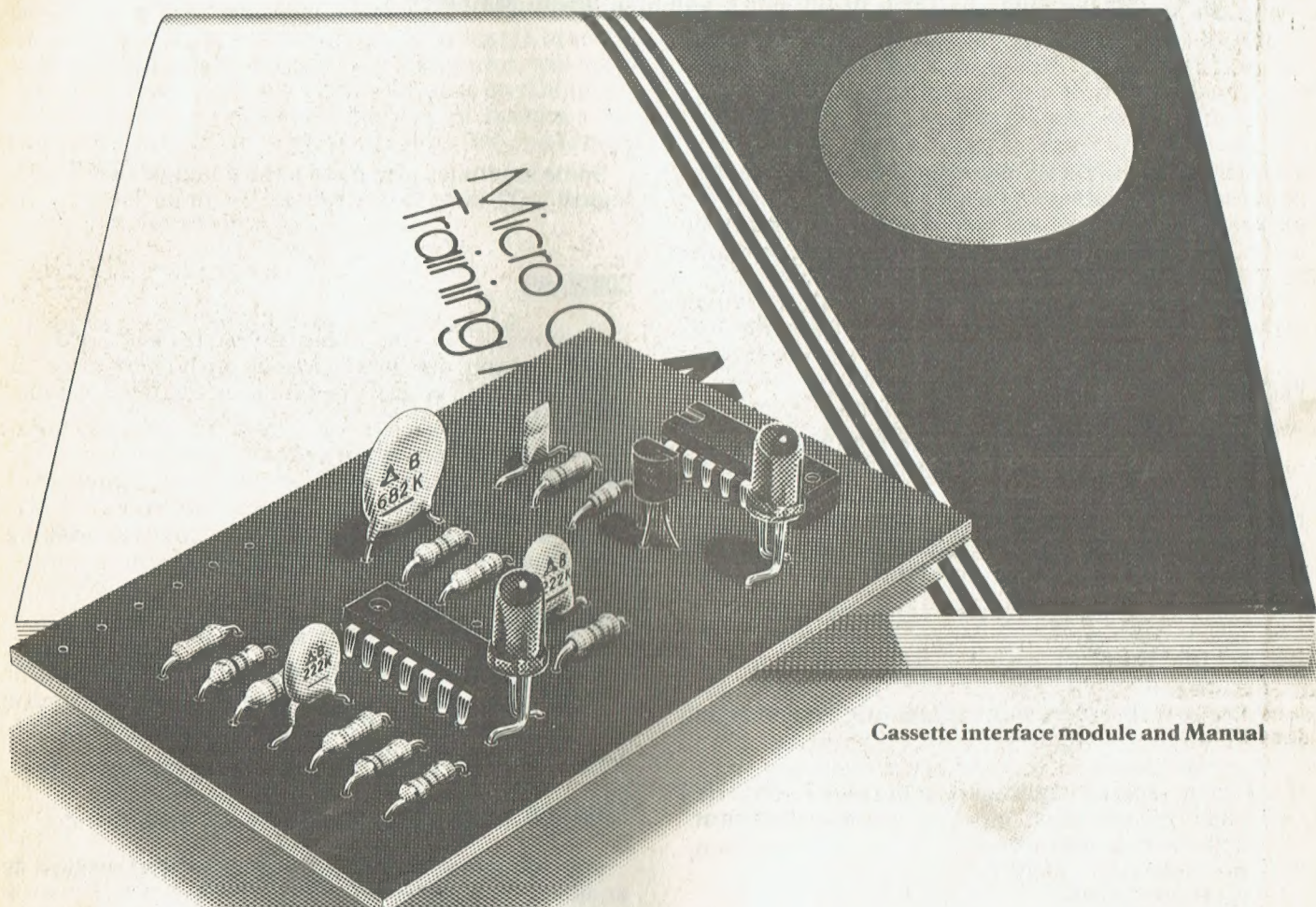
And, of course, it's a superb education and training aid — providing an ideal introduction to computer technology.

SPECIFICATIONS

MK 14

- * Hexadecimal keyboard
- * 8-digit, 7-segment LED display
- * 8 x 512 PROM, containing monitor program and interface instructions
- * 256 bytes of RAM
- * 4 MHz crystal
- * 5 V regulator
- * Single 8 V power supply
- * Space available for extra 256-byte RAM and 16 port I/O
- * Edge connector access to all data lines and I/O ports
- Optional Extras**
- * Extra RAM — 256 bytes
- * RAM I/O device

Simplest, most advanced, most flexible microcomputer -in kit form.



Cassette interface module and Manual

- * Cassette interface module
- * Revised monitor
- * PROM programmer
- * Blank PROMS

Free Manual

Every MK 14 Microcomputer kit includes a Manual which deals with procedures from soldering techniques, through programming and use of RAM I/O to interfacing with complex external equipment. It contains operational instructions and examples for training applications, and numerous programs including math routines (square root, etc), digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general purpose sequencing, etc.

Designed for fast, easy assembly

Each 31-piece kit includes everything you need to make a full-scale working microprocessor, from 15 chips, a 4-part keyboard, display interface components, to PCB, switch and fixings.

The MK 14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

How to get your MK 14

Getting your MK 14 kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK 14, return it to us within 14 days for a full cash refund.

Science of Cambridge

Science of Cambridge Ltd,
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Telephone: Cambridge (0223) 311488

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me the following, plus details of other peripherals:

- ☐ MK 14 Standard Microcomputer Kit @ £43.55 (inc 40p p&p.)
- ☐ Extra RAM @ £3.88 (inc p&p.)
- ☐ RAM I/O device @ £8.42 (inc p&p.)

I enclose cheque/money order/PO for £_____ (indicate total amount.)

Name _____

Address (please print) _____

Allow 21 days for delivery.

Beginning BASIC

Part 2 of our series looks at some of the more common BASIC statements.

THERE ARE SEVERAL dialects of BASIC in service at present, depending upon which machine you are programming for, and so we will make a start by looking at those parts of the BASIC language which are more or less universal.

The first thing to do is to define a few terms which we will be using throughout the rest of the series.

VARIABLE

A variable is a character (or sometimes group of characters) to which a numerical value may be assigned. The most common variable names and those which are used by most machines are the 26 single letters of the alphabet (A to Z). Other examples of variable names will be pointed out as we come across them.

ARITHMETIC OPERATOR

There are five common arithmetic operators in BASIC.

'=' — to be replaced by the value of (read as 'equals')
'+' — addition operator
'-' — subtraction operator
'*' — multiplication operator
'/' — division operator

Some machines have a sixth arithmetic operator '^' which means 'raised to the power of' (may also be written as '**').

COMPARISON OPERATORS

There are six common comparison operators.

'=' — equals
'<' — less than
'>' — greater than
'<=' — less than or equal to
'<>' — not equal to (can also be '≠')
'>=' — greater than or equal to

LOGICAL OPERATORS

There are two common logical operators.

'*' — logical AND (may be written as AND)
'+' — logical OR (may be written as OR)

Some machines also have a third logical operator — logical NOT (may be written as '~' or as 'NOT')

COMMAND

'Command' is the name given to keywords in BASIC which are used outside programs such as RUN, LIST, NEW etc. We will look at these in more detail later.

STATEMENT

The single instructions which go towards making up a program in BASIC are each called statements.

EXPRESSION

An expression is a collection of variables and/or numbers joined together by one or more arithmetic operators (so that $3 * X + 4$, $A - 2$ and $A * (A + B) / (2 - C)$ are all examples of expressions).

EQUATION

An equation is formed when an expression is assigned to a variable (so that $Y = 3 * X + 4$, $B = A - 2$ and $Q = A * (A + B) / (2 - C)$ are all examples of equations).

There is one other thing which should be discussed at this time. It can be described as follows—

If we let X take a value of 2 then what value do you think will be assigned to Y in the following equation.

$$Y = 3 + X * X$$

If you thought the answer was anything other than 7 or 10, then you want to brush up on your maths. If you thought the answer was 7 then you are probably wondering where 10 came from and vice-versa. It all depends on whether you used a calculator or a computer to work it out. If you used a calculator then you would have worked it out like this—

$$Y = (3 + X) * X \text{ or } Y = (3 + 2) * 2$$

executing the operators as they occur and getting an answer of 10.

If, on the other hand, you used a computer, then you would have worked it out like this—

$$Y = 3 + (X * X) \text{ or } Y = 3 + (2 * 2)$$

receiving an answer of 7. This may seem strange, but when computers do calculations they deal with the arithmetic operators in a certain order. First the computer scans the line left to right and performs all the multiplications and divisions as it encounters them; it then goes through again performing all the additions and subtractions that are left. The only way to alter the order of operations is to insert brackets where appropriate because the computer will work out the value of brackets before it does anything else and if there is more than one set of brackets one within another, it will work out the innermost brackets first.

So that, for example—

$$3 + (2 * (3 + 1 * 3)) / (2 + 1)$$

has a value of 7 by the following reasoning.

The innermost brackets contain $3 + 1 * 3$ which gives $6: 3 + (1 * 3)$: moving out to the outermost brackets we multiply this by 2 to give 12. This is one partial solution. We then move on to the last pair of brackets containing $2 + 1$ and evaluate this as 3. That takes care of all the brackets and gives an expression which looks like this—

$$3 + 12 / 3$$

Division now comes before addition and this reduces to—

$$3 + (12 / 3) \text{ or } 3 + 4$$

then the addition is done to give a final answer of 7.

Try evaluating the following expression—

$$7 + ((7 * 8) / 2) / (((12 + 8) * 2) / 20)$$

When you have done this, try taking out all the unnecessary brackets (parentheses) without rearranging the order of the numbers (constants) and arithmetic operators so that the resulting expression gives the same result. The answers are given at the end of the article.

Certain facilities are required from any high level language, BASIC being no exception.

1. There must be a way of assigning values to any variables used in a program;
2. A method of outputting answers is also a must;
3. The language must have branching capabilities and in particular conditional branching must be provided;
4. Other facilities such as subroutines, string handling and some pre-defined functions are also useful and are usually provided.

LET

In BASIC the easiest way of defining a variable is to use a LET statement.

```
10 LET X = 3
20 LET Y = X - 2
30 LET T = T + 1
```

There are several things that you should notice here. Firstly, every instruction is preceded by a line number.

The computer, in executing a program in BASIC, does so in sequential line number order, starting with the lowest numbered line and going through to the highest numbered line except where a branching instruction is encountered in which case the next line number to be executed forms part of the instruction.

Secondly, the '=' sign in these instructions does not mean 'equals' in the normal sense of the word, but means 'to be replaced by the value of'. So that line 20, when translated into English, means something like this—

LET whatever exists now in the memory locations representing the variable Y 'be replaced by the value of' whatever exists now in the memory locations representing the variable X, minus 2.

This may seem a bit of a tongue twister (it would normally be read as "LET Y equal X minus 2") and has only been presented in this form to make line 30 a little easier to understand.

LET T = T + 1

What does it mean?

Well, briefly, if the memory space for the variable T had a value of 2 before the execution of line 30, it would have a value of 3 after its execution. Got it? If not, refer back to the tongue twister, substituting the variables and constants from line 30 into line 20 where appropriate and read it through a couple of times until you have mastered this concept, because it is very important. You should now be able to see (if you read Part 1) that where the following flow chart box appears—

ADD 1 to A

this could now be replaced by a box containing the following BASIC statement—

LET A = A + 1

It is reasonable to point out at this time that on most machines which can run BASIC the LET statement is optional so—

```
10 LET A = A + 1
and
10 A = A + 1
```

are equally valid statements so that where, last month, we encountered the following—

To be continued ►

A = 1

we were (apart from line numbers) already considering BASIC statements.

GOTO

The simplest form of branching instruction in BASIC is the GOTO statement, an example of its use is seen below—

```
10 LET Y = 1
20 LET A(Y) = Y * Y
30 LET Y = Y + 1
40 GOTO 20
```

The format of the GOTO statement is quite straightforward. The keyword GOTO is followed by the number of the line to which you wish control of the program to be transferred. Therefore, this program segment would be executed in the following order—

10 20 30 40 20 30 40 20 etc

As well as the GOTO statement, a new type of variable has been introduced in this program segment; the single subscript variable (can be known as a one dimensional array) represented here by the variable name A(Y). In Tiny BASIC as well as having single letters to represent variables (A, B, K, Y etc) you can also use variables of the following format—

A(1), A(2), A(10), A(50) etc

where A(1) is as different from A(2) as X is from Y (The ETI Triton uses the @ symbol for its one single subscript variable, the TRS-80 Level I uses A).

Can we think of a use for these new variables? Well, if we think back to last month's card shuffling routines, we came across the following—

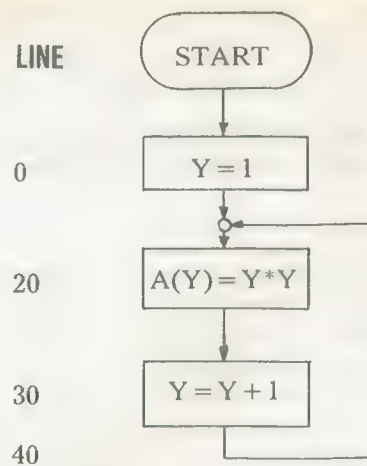
Put Random Number
R In Storage
Location A

where A took values from 1 to 52.

If we say that A(1) is storage location 1 and A(2) is storage location 2 or, in more general terms, A(A) is storage location A, then we have a representation for what was last month a set of 52 storage locations. So it is now obvious that the above flow chart box could be replaced by the following—

A(A) = R

Right! Let's go back to the program segment illustrating the GOTO statement.



This is its flow chart. We can see flow chart boxes representing lines 10, 20 and 30, but there is no box to represent the GOTO statement. It is merely represented by the box interconnection line which branches back to the connector between lines 10 and 20. While we are still on the subject, let's see what this program segment is actually doing (mentally executing a program without the aid of a computer is called DRY RUNNING a program).

Line 10 is the first line to be executed and all it is doing is assigning an initial value to the variable Y (in this case the value is 1). Now comes the line that might cause a bit of a problem.

20 LET A(Y) = Y * Y

If we think about the current value of the variable Y and substitute this value in the appropriate places, then what we end up with should make a lot more sense.

20 LET A(1) = 1 * 1

All this says is "write 1(1*1) into the memory space representing the variable A(1).

Now we pass on to line 30, which we have met previously, and this line adds 1 to the memory locations representing the variable Y; so Y now has the value 2.

Line 40 is the GOTO statement which tells us that the next line to be executed is line 20 again, and so we go back and re-write.

20 LET A(Y) = Y * Y

as

20 LET A(2) = 2 * 2

using the new value of Y so that we write 4(2*2) into the memory space representing the variable A(2). This process is now repeated for variables A(3) A(4) A(5) and so on. Unfortunately, we have included no method of stopping the program or of branching out of this loop as we have not yet covered such things, but bear with us and all will be revealed.

You may have noticed from the explanation so far given that this program segment is calculating the points for a graph of $y = x$ and if we could look into the memory spaces representing the values of the variable A(Y) we would see the following—

A(1) ... 1
A(2) ... 4
A(3) ... 9

One of the unfortunate points about this program is that it is an infinite loop (ie it will go on for ever with increasing values of Y) so we will now go on to look at a method of controlling the number of times we go round the loop.

TO BE CONTINUED

COMPUTING TODAY — DECEMBER 1978

MICRODIGITAL of Merseyside

WE SELL . . .

Science of Cambridge MK 14
Bearbags
Nascom
Rockwell AIM-65
Apple II
North Star Horizon
CASU
Panda

Chroma Chimes
Monitel
Chess/Draughts/Backgammon
A superb selection of literature
TI Programmer Calculator
Multimeters, Soldering
Equipment, Wire Wrap, etc.
and much more

Demonstrators of most of these on display

Opening hours: 9-5.30 Monday to Saturday

Friendly, expert staff always on hand!



MICRODIGITAL LTD.

25 BRUNSWICK STREET
LIVERPOOL L2 0BJ

Tel: 051-236 0707

THIS MONTH'S SPECIAL POSTAL OFFERS

10 quality C15 cassettes
with library cases and
special labels. **£4.75** ☐

Science of Cambridge
Socket Set 5x14 pin, 7x16
pin, 4x18 pin, 2x40 pin. **£3.89** ☐

Science of Cambridge
power supply. **£4.86** ☐

Universal microprocessor
coding forms, pads 100
sheets each. **£2.38** ☐

above offers include V.A.T. and P. & P.

Please send me the items ticked above. I
enclose Cheque/P.O. for.

or

Access No. Barclaycard No.

Please send me free, complete brochure. I
enclose S.A.E. ☐ (please tick).

Name.

Address.

. Tel. No.

Address to:
MICRODIGITAL LTD., 25 BRUNSWICK STREET,
LIVERPOOL L2 0BJ.

Please allow 14 days for delivery.

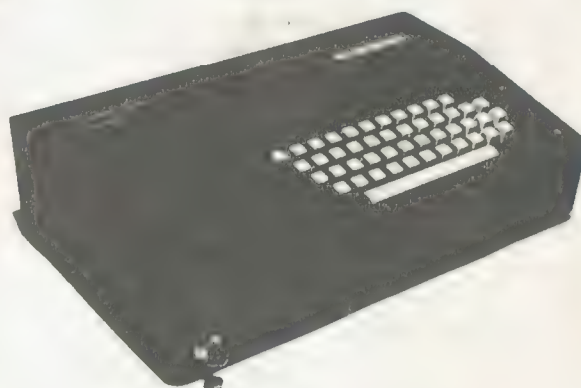
ANNOUNCING THE **MICROS**

JOIN THE MICRO REVOLUTION

£399 for a Z80 based microcomputer, built and tested

Designed for educational establishments, personal
computing and small business users

- * Includes 1K monitor Eprom, 47 key solid state keyboard, video, TV, cassette and teletypewriter interfaces, serial i/o, 2 parallel i/o ports, 2K bytes RAM, power supplies and instrument housing.
- * Connect to domestic TV or video monitor to complete the system
- * 48 x 16 character video matrix
- * 47 key contactless ASC11 keyboard
- * Hard copy on teletypewriter
- * 2 TTL compatible parallel i/o ports
- * RS232 serial i/o port
- * Load and dump programmes on unmodified cassette recorder



- * Up to 16K byte mixed RAM and Eprom in table top housing
- * Expandable up to 64K bytes
- * Security locked power switch
- * British designed and built
- * Available in kit form for £360
- * Credit terms available

THE MICRONICS COMPANY

1, STATION ROAD TWICKENHAM MIDDLESEX

PART OF THE MICRO REVOLUTION

Prices exclusive of VAT and carriage



NewBear Computing Store



★ SYM-1 ★

(Formally VIM-1)

The new 6502 micro from Synertek. Fully assembled and tested

Ex Stock @ **£199.00**

+ 8% V.A.T.
Carriage £1.00

★ NASCOM 1 ★

**Z80 BASED
MICROCOMPUTER KIT**

Ex Stock @ **£197.50**

+ 8% VAT
£1.00. Carriage

LIMITED SPECIAL OFFER! ★ N.L. 7001 V.D.U's.

(1977 Model)

- ★ 12" TUBE
- ★ FULL PROFESSIONAL ASCII KEYBOARD
- ★ V24 INTERFACE AND CURRENT LOOP
- ★ SWITCHABLE FULL AND HALF DUPLEX
- ★ ALL METAL CASE
- ★ BAUD RATE SWITCHABLE BETWEEN 50 AND 9600 BAUD

PLUS 8% VAT
PLUS CARRIAGE

ONLY
£395

BEAR BAGS

1. 77-68 CPU PCB and Components £49.50
2. 77-68 LED's and Switches £14.95
3. 77-68 Power Supply £17.95
4. 77-68 19" 5u Rack and Backplane £26.70 +
5. 77-68 4K Ram PCB and Components £74.00
6. 77-68 Mon 1 PCB and Components £50.00
7. 4K Ram Exorciser PCB and Components £71.50
8. 8K Ram Exorciser PCB and Components £160.00*
9. Petitevid VDU Kit £85.00
10. Kansas City Cassette Interface £18.95
11. UHF Modulator £4.50
12. 77-68 VDU PCB and Components £69.50
13. 77-68 Mon 2 PCB and Components Et.b.a.
14. Prom Programmer PCB and Components £35.00
15. PROMVERTER (Enables a 2708 to be used instead of MIKBUG) £8.50

*50p Postage and Packing unless otherwise stated + £1.50 Postage and Packing.
*£1.00 Postage and Packing.

- Instant Freeze-Dried Computer Programming in basic.
By Jerald R. Brown £4.95 75
- My Computer Likes Me When I Speak in Basic £1.65 30
- Computer Programs that Work £2.40 75
- Basic Software Library
- | | | |
|-----------|--------|----|
| Volume 1: | £17.50 | 50 |
| Volume 2 | £17.50 | 50 |
| Volume 3 | £26.95 | 50 |
| Volume 4 | £7.95 | 50 |
| Volume 5 | £7.95 | 50 |
| Volume 6 | T.B.A. | 50 |
| Volume 7 | £26.95 | 50 |

NEW BOOKS

- First Book of Kim £7.00 50
- Z80 Microcomputer Handbook £7.25 50
- Using the 6800 Microprocessor £6.25 50
- Micro 6502 Journal £1.70 50
- Learning Basic Fast £6.30 50
- How to Program Microcomputers £6.30 75
- Getting involved with your Own Computer
- | | | |
|---------------|-------|----|
| | £4.75 | 75 |
| 8080A Bugbook | £6.95 | 75 |

Z80 CPU 2.5 MHz	2708	£6 99
£15.50	2716	£22 50
Z80 P10 PS	MIKBUG	£13.65
£10.00	4116	£15.00
Z80 CTC PC		
£10.00		
Z80A CPU 4MHz	Interfacing I.C.'s	
£20.50	SFF 96364	
		£16.20
Z80A PIO	MC 1488P	£1.40
Z80A CTC	MC 1489P	£1.40
MC 6800	75150P	£1.30
MC 6820	75150N	£1.20
MC 6850	75154	£2.30
MC 6810	4N33	£1.95
MC 8602P	AY-5-1013	£4.50
MC14536P	6402	£4.50
MC 3459	6571	£6.70
SC/MP II	2501	£6.50
6502		
£14.93		
8080A		
£8.00		

Buffers

Memories		81LS95	£1.30
2102-1	£1.25	81LS96	£1.30
2102L-1	£1.35	81LS97	£1.30
2112	£3.04	81LS98	£1.30
2513	£6.50	8T26	£1.84
SWATBUG		8T95	£1.60
	£16.00	8T97	£1.60
2114	£8.25	74367	£1.30

COMPUTER DESIGNS

77 68 6800 Microcomputer	£7.50	P&PP
Spare Diagram Set for 77-68	£1.50	.50
WB-1 TTL Microcomputer	£6.50	.50
Spare Diagram Set for WB-1	£1.00	.50

FROM ADAM OSBOURNE ASSOCIATES

Introduction to Microcomputers		
Volume 0 The Beginners Book	£5.95	.50
Volume 2 Basic Concepts	£5.95	.50
Volume 2 Some Real Products June 1977 Revision	£11.95	1.00
8080A/8085 Assembly Language Programming	£6.95	.50
6800 Assembly Language Programming	£6.95	.50
Some Common Basic Programmes	£5.95	.50
6800 Programming for Logic Design	£5.95	.50
8080 Programming for Logic Design	£5.95	.50
Payroll with Cost Accounting in Basic	£9.95	1.00

SCELBI

Understanding Microcomputers & Small Computer Systems	£7.56	.50
Scelbi 6800 Software Gourmet Guide & Cookbook	£7.95	.50
Scelbi 8080 Software Gourmet Guide and Cookbook	£7.95	.50
8080 Standard Assembler	£15.95	.75
The Scelbi Byte Primer	£9.95	1.00
The 8080 Programmers Pocket Guide	£2.35	.30

ZILOG

Z80 Technical Manual	£4.00	.50
Z80 PIO Technical Manual	£22.50	.50

MOTOROLA

Understanding Microprocessors	£2.75	.30
M6800 Microprocessor Programming Manual	£4.50	.50
M6800 Microprocessor Applications Manual	£9.50	1.00

SYBEX

Microprocessors C201	£8.00	.50
Microprocessor Interfacing Techniques	£8.00	.50

24-HOUR TURN-AROUND ON ORDERS

Please add 8% VAT to all prices. P&P 30p unless otherwise stated. Barclaycard and Access welcome. Overseas orders issued with Pro-Forma Invoice. Send for catalogue to NewBear Computing Store, Bone Lane, Newbury, Berks. Callers welcome Mon.-Sat., 9.00-5.30, but please phone us first on 0635 49223. New office — 2 Gatley Road, Cheadle, Cheshire. (Callers only). Telephone. 061-491 0134.

ETI BOOK SERVICE

— computing —

BASIC: A Self Teaching Guide (2nd Edition) £4.50
by ALBRECHT, R. L.

Teach yourself the programming language BASIC. You will learn how to use the computer as a tool in home or office and you will need no special maths or science background.

Illustrating BASIC £2.20
by ALCOCK, D.

This book presents a popular and widely available language called BASIC and explains how to write simple programs

Microprocessors £10.65
by ALTMAN, L.

Gives a general overview of the technology design ideas and explains practical applications.

Applying Microprocessors £12.00
by ALTMAN, L.

Follow up volume which takes you into the second and third generation devices

Intro to Microprocessors £6.00
by ASPINALL, D.

Explains the characteristics of the component.

How to Buy and Use Minicomputers and Microcomputers £7.50
by BARDEN, W.

Discusses these smaller computers and shows how they can be used in a variety of practical and recreational tasks in the home or business.

How to Program Microcomputers £6.75
by BARDEN, W.

This book explains assembly-language programming of microcomputers based on the Intel 8080, Motorola MC6800, and MOS Technology MCS6502 microprocessors

Introduction to Microcomputers and Microprocessors £7.50
by BARNA, A.

Provides the basic knowledge required to understand microprocessor systems. Presents a fundamental discussion of many topics in both hardware and software

Microprocessors in Instruments and Control £11.80
by BIBBERO, R. J.

Introduces the background elements, paying particular regard to the dynamics and computational instrumentation required to accomplish real-time data processing tasks

Basic BASIC £7.50
by COAN, J. S.

An introduction to computer programming in BASIC language.

Microprocessor Programming for Computer Hobbyists £7.00
by GRAHAM, N.

The Computer Book £6.20
by HAVILAND, R. P.

Building super calculators and minicomputer hardware with calculator chips

Microcomputers, Microprocessors, Hardware Software and Applications £14.25
by HILBURN, J. L.

Complete and practical introduction to the design, programming, operation, uses, and maintenance of modern microprocessors, their integrated circuits and other components

Microprocessor Systems Design £14.35
by KLINGMAN, E.

Outstanding for its information on *real* microprocessors, this text is both an introduction and a detailed information source treating over a dozen processors, including new third generation devices. No prior knowledge of microprocessors or microelectronics is required of the reader.

BASIC Programming £6.10
by KEMENY, J. G.

A basic text.

Microprocessor and Small Digital Computer Systems for Engineers and Scientists £19.00
by KORN, G. A.

This book covers the types, languages, design, software and applications of microprocessors.

TV Typewriter Cookbook £7.40
by LANCASTER, D.

An in-depth coverage of tv typewriters (tvts)—the only truly low-cost microcomputer and small-system display interface. Covers tvt terminology, principles of operation, tv configurations, memories, system design, cursor and update circuitry and techniques, hard copy, color graphics, and keyboards and encoders.

Microprocessors — Technology, Architecture, and Applications £8.00
by McGLYNN, D. R.

This introduction to the "computer-on-a-chip" provides a clear explanation of this important new device. It describes the computer elements and electronic semiconductor technologies that characterize microprocessors.

Programming Microprocessors £5.50
by McMURRAN

A practical programming guide that includes architecture, arithmetic/logic operations, fixed and floating-point computations, data exchange with peripheral devices/compilers and other programming aids.

Microcomputer Based Design £19.00
by PEATMAN, J. B.

This book is intended for undergraduate courses on microprocessors.

Microprocessor and Microprocessor Systems £20.50
by RAO, G. U.

A completely up-to-date report on the state of the art of microprocessors and microcomputers, written by one of the leading experts. It thoroughly analyzes currently available equipment, including associated large scale integration hardware and firmware.

The 8080A Bugbook: Microcomputer Interfacing and Programming £7.60
by RONY, P. H.

The principles, concepts and applications of an 8-bit microcomputer based on the 8080 microprocessor IC chip. The emphasis is on the computer as a controller.

6800 Software Gourmet Guide and Cookbook £7.80
by SCELBI

8080 Software Gourmet Guide and Cookbook £7.80
by SCELBI

Understanding Microcomputers £7.60
by SCELBI

Microprocessors and Microcomputers £18.00
by SOUCEK, B.

Here's a description of the application, programming, and interfacing techniques common to all microprocessors. It concentrates on detailed descriptions of representative microprocessor families and includes explanations of digital codes, logical systems, and microcomputer organization.

Microcomputer Primer £6.25
by WAITE, M.

Introduces the beginner to the basic principles of the microcomputers. Discusses the five main parts of a computer — central processing unit, memory, input/output interfaces, and programs. The important characteristics of several well-known microprocessors are given and a chapter is included on programming your own microcomputer.

Microprocessor/Microprogramming Handbook £6.00
by WARD

Authoritative practical guide to microprocessor construction, programming and applications.

HOW TO ORDER:

Make cheques etc payable to ETI Book Service. Payment in sterling only please. Orders should be sent to: ETI Book Service, PO Box 79, Maidenhead, Berks. All prices include P & P.





nm
£197.50
 + VAT 8%
 POST PAID

NASCOM I MICRO-COMPUTER for the HOBBYIST

As reviewed in E.T.I. Nov. '78:
 "Overall the Nascom is an excellent unit"

THE COMPLETE MICRO-COMPUTER AVAILABLE TO THE HOME CONSTRUCTOR

FEATURES

- ★ Supplied in kit form for self-assembly
- ★ Full documentation supplied
- ★ Fully screened double sided plated through hole printed circuit board
- ★ Full 48 key keyboard included
- ★ 2K x 8 Ram
- ★ 1K x 8 monitor program in Eprom
- ★ Powerful Mostek Z80 CPU
- ★ 16 x 48 character display interface to std un-modified T.V.
- ★ T.V. display memory mapped for high speed access
- ★ On board expansion to 2K x 8 Eprom
- ★ On board expansion for additional 16 I/O lines
- ★ Memory may be expanded to full 60K (plus 4K existing on board)

SOFTWARE FEATURES

- ★ 1K x 8 monitor program providing
- ★ 8 operating commands, supporting Mem examine/modify, tabulate, copy, break, single step execute tape, load, tape dump
- ★ Reflective monitor addressing for flexible monitor expansion through user programs
- ★ Monitor sub-routines include — delay ASCII coding, binary to hex conversion, clr screen, scroll up, string print, cursor shift and many others

EXPANSION

- ★ Expansion buffer board **£25.00**
- MEMORY KITS** (inclusive all hardware)
- 8K **£85.00**
- 16K **£140.00**
- 32K **£200.00**
- ★ I/O board with decoders and all hardware except ICS will accept up to 3 PIOs, 1 CTC and 1 UART **£35.00**

NEW "B-BUG" extended monitor in 2K of EPROM Fully software compatible with NASBUG, supporting additional features — Full keyboard shift for all 128 characters, full cursor movement routines, Read and Write commands (fast tape load and dump), H and N commands (for inserting ASCII code directly into programme), Arith command (for calculating relative jumps), Generate command (for automatic programme start) Intelligent copy (for non-destructive re-location of DATA), Random, block handling, ASCII to BCD and BCD to ASCII routines and many more 2 EPROMS + full documentation — **£21.66**.

★ S.a.e. for full expansion details.

OTHER HARDWARE

- ★ 3A power supply for up to 4K expansion **£19.90**
- ★ 8A power supply for larger than 4K expansion **£60.00**
- ★ Expansion card frame **£29.50**
- ★ Programming manual **£4.00**
- ★ Hardware & software manuals (supplied in kit) **£3.00**

Export Trade, Government and Educational Enquiries Invited

Add VAT at 8% on all items except manuals

Demonstrations Continuous at our Store



Construction Manuals Separately **£3.00**

Complete Kits NOW IN STOCK

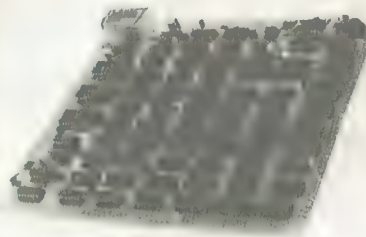
£197.50
 +VAT 8%
 POST PAID

Sole Appointed London Stockists

HENRY'S RADIO

HENRY'S RADIO
 404 Edgware Rd. London W2
 PHONE (01)723 1008

TANGERINE COMPUTER SYSTEMS LIMITED



DON'T FORGET SPECIAL OFFER
£10 discount
 on orders dated before Dec. 12.
 So hurry!

The new low cost VDU - Tangerine 1648
 (See page 16, ETI, Oct. '78 for feature details)

ORDERING INFORMATION

The normal **KIT price is £139.86**, which includes postage, packing and insurance and VAT @ 8%. HOWEVER, as an introductory gesture we are **discounting this price by £10**; for all orders received postmarked **BEFORE 12th December, 1978**.

If you require further information, send an A4 sized self-addressed envelope. If you wish to purchase a kit please send a cheque or money order made payable to

TANGERINE COMPUTER SYSTEMS LIMITED

RIVERMILL LODGE, LONDON ROAD, ST. IVES, CAMBS. PE17 4BR
 Tel. St. Ives (0480) 65666



THE TOTAL SOLUTION FROM ALMARC OF COURSE!

Now Almarc & Vector Graphic offer the complete solution to your computing needs for £2300.00*. The Vector MZ needs only the addition of a V.D.U. and it's ready to go. Completely assembled and fully tested, the Vector MZ offers the following features as standard: —

- S-100 bus
- 4 MHz Z80A processor
- 158 instructions
- Two quad density Micropolis floppies — over 630k bytes on line
- Serial port
- Two parallel ports
- 32K static ram
- 12K prom/ram board with extended monitor
- Extended disc Basic

Simply connect your peripherals (Elbit V.D.U.s & Centronics printers are available from Almarc) and you're up and running and, because the MZ uses the S-100 bus, you can plug in a massive range of add-on units.

Ring or write for a demonstration to: —

ALMARC DATA SYSTEMS LTD.

29 Chesterfield Drive
 Burton Joyce, Nottingham
 Tel: 0602 248565

*Discount terms available

MICROBIOGRAPHY

THE 8080

This month we begin a series of in-depth interviews with various CPU celebrities — starting with the device used in the TRITON.

THE INTEL 8080 has become an industry standard. For those of you with mainframe computing experience, it is the FORTRAN of processors — vast amounts of software are available for it and many people have experience of it.

It was for this reason that it was used in the ETI TRITON. Not only does it have its own software following, it will also run programs written for the earlier 8008 and the much more advanced Z-80 will (with a little help, no doubt) run 8080 programs, although writing for the Z-80 is more demanding.

What we hope to provide in this series of articles is enough information on a number of processors to enable the reader to decide which is best for a particular application.

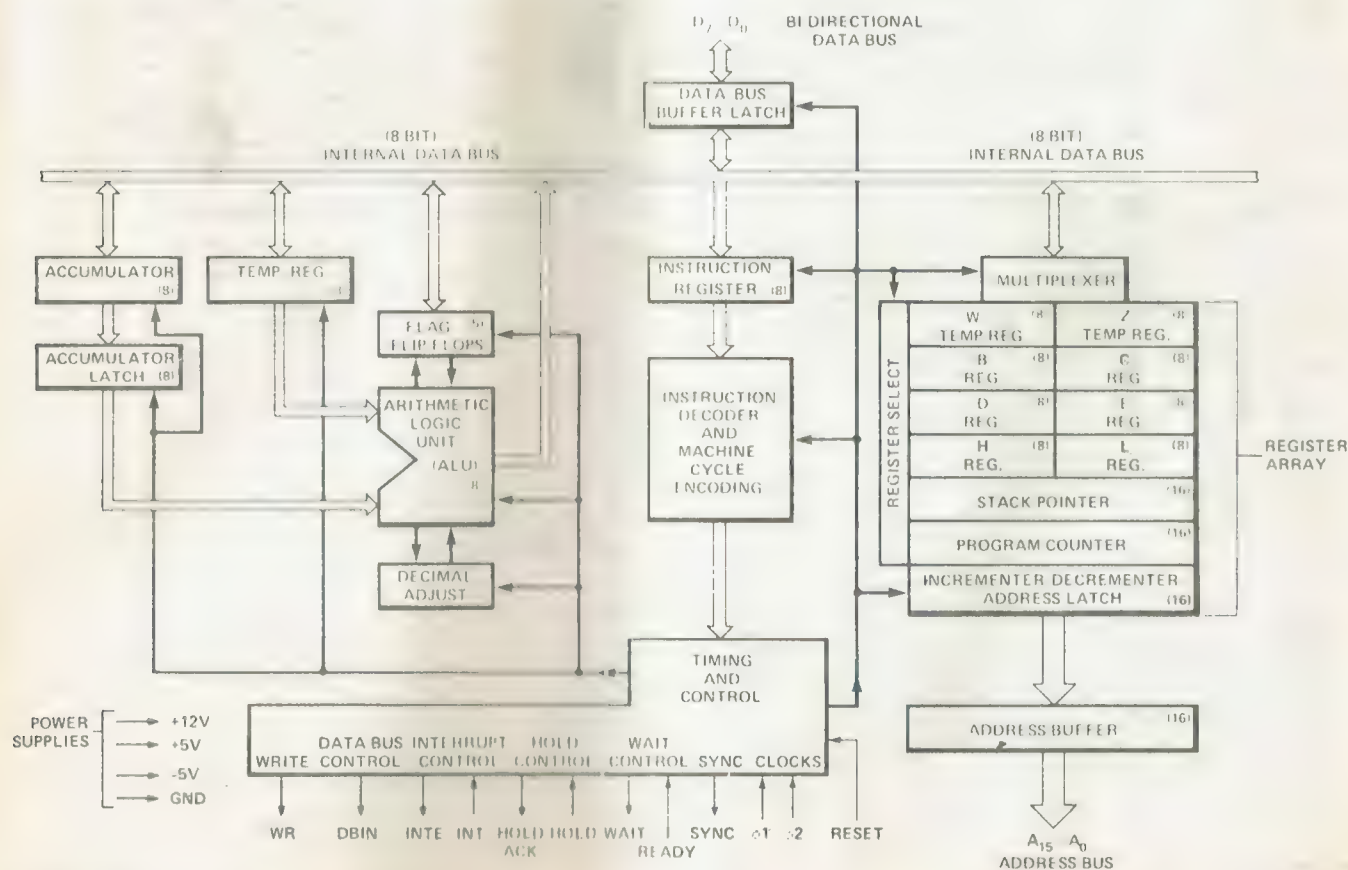
Registers

Not all of the registers shown on Fig. 1 are available to the programmer. The ones which are available are:

The accumulator;
registers B, C, D, E, H and L;
the stack pointer
and the program counter.

The accumulator

This is the scratch-pad of the CPU. Most instructions allow you to prod the accumulator in some way. The state of the contents of the accumulator affects the flags (see below).



Registers B, C, D, E, H and L

The CPU allows you to move data from register to register in this set but if you want to do anything clever to the data you have to put it into the accumulator.

Register pairs B&C, D&E, H&L and the stack pointer

Some of the instructions allow you to treat some pairs of registers as one 16-bit register (each individual register holds 8 bits). The allowable pairs are shown above. Most of these instructions can also be used on the stack pointer, which holds 16 bits.

Register pair H&L

Instructions which refer to a particular byte of memory usually do so by means of the H&L registers. The memory location is held in these registers (most significant 8 bits in the H register).

Program counter

This points to the position in the program which the CPU is at. By changing this (via jump instructions), the CPU can be made to jump to a different part of the program.

Stack pointer

One of the nice things about the 8080 is its ability to keep a stack in external memory automatically.

What is a stack, you ask?

A stack is like a stack of magazines. When you put data 'onto' the stack, the CPU will add 1 to the stack pointer and then put the data into the memory location which the stack pointer is 'pointing' at (i.e. the top of the pile). When you take data off the top of the stack, the CPU will copy it from the stack pointer location and then subtract 1 from the stack pointer.

This is very useful for interrupts, during which the CPU is asked to stop what it is doing and go and do something else. When this happens the CPU can save all the register contents by putting them onto the

THE 8080 INSTRUCTION SET

r stands for register eg A register
rp stands for register pair, eg b and C registers
'data' means the contents of the second or second and third bytes of the instruction
M stands for memory whose address is in the H and L registers

DATA TRANSFER GROUP

MOV r1, r2	Move register to register
MOV M, r	Move register to memory
MOV r, M	Move memory to register
MVI r, data	Move immediate (to register)
MVI M, data	Move immediate (to memory)
LXI rp, data 16	Load immediate (to register pair or to stack pointer)
STA addr	Store direct (accumulator to memory)
LDA addr	Load direct (memory to accumulator)
XCHG	Exchange H&L with D&E registers
STAX rp	Store accumulator indirect (with address in registers B&C or D&E)
LDAX rp	Load accumulator indirect (with address in registers B&C or D&E)
SHLD addr	Store H&L direct
LHLD addr	Load H&L direct

ARITHMETIC GROUP

INR r	Increment register
DCR r	Decrement register
INR M	Increment memory
DCR M	Decrement memory
ADD r	Add register to A
ADC r	Add register to A with carry
SUB r	Subtract register from A
SBB r	Subtract register from A with borrow
ADD M	Add memory to A
ADC M	Add memory to A with carry
SUB M	Subtract memory from A
SBB M	Subtract memory from A with borrow
ADI data	Add immediate to A
ACI data	Add immediate to A with carry
SUI data	Subtract immediate from A
SBI data	Subtract immediate from A with borrow
INX rp	Increment register pair (or stack pointer)
DCX rp	Decrement register pair (or stack pointer)
DAA	Decimal adjust A (gives two BCD digits)
DAD rp	Add B&C, D&E or H&L to H&L

LOGIC GROUP

ANA r	AND register with A
XRA r	EXCLUSIVE-OR register with A
ORA r	OR register with A
CMP r	Compare register with A
ANA M	AND memory with A
XRA M	EXCLUSIVE OR memory with A
ORA M	OR memory with A
CMP M	Compare memory with A
ANI data	AND immediate with A
XRI data	EXCLUSIVE-OR immediate with A
ORI data	OR immediate with A
CPI data	Compare immediate with A
RLC	Rotate A left
RRC	Rotate A right
RAL	Rotate A left through carry
RAR	Rotate A right through carry
CMA	Complement A
STC	Set carry
CMC	Complement carry

BRANCH GROUP

JMP addr	Jump unconditional
Jcond addr	Jump on condition specified (carry, no carry, zero, no zero, positive, minus, even or odd parity)
CALL addr	Call unconditional
Ccond addr	Call on condition specified (see above)
RET	Return
Rcond	Return on condition specified (see above)
RST	Restart
PCHL	H&L to program counter

STACK, I/O AND MACHINE CONTROL GROUP

HLT	Halt
IN port	Input (from port to A)
OUT port	Output (from A to port)
PUSH rp	Push register pair on stack (in memory)
PUSH PSW	Push A and flags on stack
POP rp	Pop register pair off stack
POP PSW	Pop A and flags off stack
XTHL	Exchange top of stack with H&L
SPHL	Move H&L to stack pointer
EI	Enable interrupts
DI	Disable interrupts
NOP	No op

THE 8080

stack. When the interrupt is over it can then read them back off the stack and go back to what it was doing.

This facility is also useful for subroutine calls.

Flags

A flag in this context is nothing to do with patriotism. It is one bit of a register which signals a particular condition.

There are five flags in the 8080's ALU:

zero, parity, carry, auxiliary carry and sign.

All of them reflect the state of the data in the accumulator. They are accessed by means of the conditional jump class of instruction.

The interrupt enable flag (see Fig. 2) can also be set or reset by machine code instruction.

Instruction Set

Table 1 shows the 8080 instructions set.

The POP and PUSH instructions take data from and put data onto the stack, respectively.

The rotate class of instructions make the accumulator act like a shift register.

Increment and decrement add or subtract 1 from the relevant registers, respectively.

The NOP instruction is useful where there may be some changes in the program — to save shifting the rest of it to get more room.

Addressing Modes

The different ways in which the data following the machine code instruction byte can yield data are called 'addressing modes'. The ones which the 8080 uses are:

Immediate mode: Bytes 2 and/or 3 of the instruction contain the 8 or 16 bits of data to be used.

Direct addressing: Bytes 2 and 3 contain the address of the data in memory.

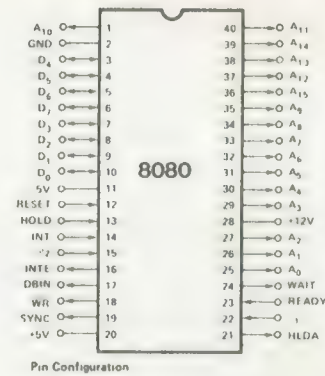
Register addressing: The instruction specifies which register the data is in.

Register indirect addressing: The instruction specifies a register pair (giving 16 bits) which is the address of the data in memory.

These modes are implicit in the description of the instruction set in Table 1 but the list shown above gives a useful overview.

Summary

The 8080 is a good general purpose CPU with adequate arithmetic operations. The instruction set is easy to follow and easy to use. The stack facility is nice, slightly marred by the lack of any single-byte stack instructions.



A0-A15: Address bus. Provides the address of a required memory location or I/O device number. Least significant bit = A0.

D0-D7: Tri-state bidirectional data bus. Least significant bit = D0.

SYNC: Indicates the beginning of each machine cycle.

DBIN: Indicates that the data bus is ready for data input.

READY: Tells the CPU that valid data is on the data bus, ready for input. If requiring data, the CPU will enter a 'wait' state until READY goes high.

WAIT: Active when CPU is in 'wait' state.

WR: Shows that the data bus carries valid output.

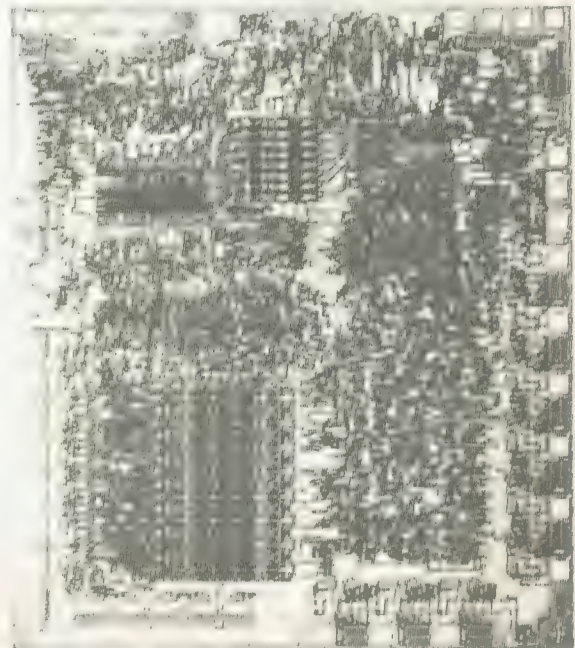
HOLD: Request to CPU to stop what it is doing and make the address and data busses high impedance.

HOLDA: High when CPU acknowledges the HOLD request and goes into a HOLD state.

INTE: INTE high means that the CPU will accept maskable interrupts. The state of INTE can be changed by the relevant machine code instruction.

INT: Interrupt request. Asks the CPU to jump to the relevant interrupt address.

RESET: Clears the program counter, INTE and HLDA.



WIN A TRITON

HOW TO ENTER

Solve the clues shown and enter them on the form below as though it were a cross-word but you will be entering numbers. In some cases leading zeros must be supplied.

Some of the clues are tough — but they are not tricks and those which you cannot answer from your head will be available in common reference books, from past issues of ETI, in particular the November issue featuring the TRITON. Note: Any arithmetic must be performed with TRITON's TINY BASIC's restrictions in mind.

RULES

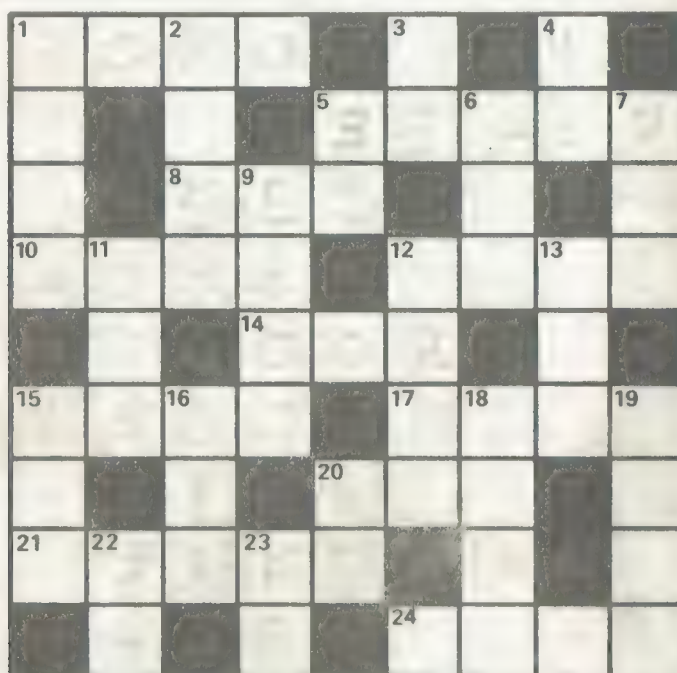
This competition is open to all U.K. and Northern Ireland readers of Electronics Today International except employees of the magazine, their printers, distributors, employees of TRANSAM, and anybody associated with the competition.

All entries must be on the coupon cut from the magazine, photostats are not acceptable. As long as the correct coupon is used, readers may submit as many entries as they wish.

Completed entries should be sent to 25/27 Oxford Street, London W1R 1RF and marked Computing Today Competition.

The Prize will be awarded to the first correct entry drawn after the closing date. No correspondence can be entered concerning the competition. It is a condition of entry that the judges' decision in all matters is regarded as final.

The winners will be notified by post. The answers and the names of the prizewinners will appear in a future issue of E.T.I.



ACROSS

1. TRITON'S intelligent MPU
5. BASIC's largest number
8. Tick-tock UART's clock
10. 4K
12. $100 \times 11 + 27 + 5/6$
14. Secret agent
15. Motorola's best known MPU
17. Controlling influence for TRITON
20. Bit of a reverse (see 16)
21. Needle in a STAC
24. Remember this IC

DOWN

1. Tick-tock TRITON's clock
2. Intel's programable interrupt controller
3. To to the fife.

4. No. of add. lines
5. Put a hex on 065 (Octal)
6. Operate on this amp.
7. The first is there, repeat for the rest
9. Green blue red (resistively speaking)
11. We've just ate here
12. Give us a ring
13. 24 across with nothing removed
15. $41/2 + 100 \times 6 - 5$
16. Backward 6 (in binary)
17. In control of TRITON
18. S.F. classic
19. Any port in a storm
20. Hecks its 4 down
22. Logic series
23. 8 bit MPU's max. address

Name

Address

CLOSING DATE DECEMBER 31st 1978

MEMORIES

2112 (256 x 4 Static RAM)	£1.11
21L02 (450ns)	£1.07
(1K x 1 Static RAM)	
21L02 (250ns)	£1.60
2114 (1K x 4 Static RAM)	£7.70
4027 (300ns, equiv 2104)	£2.02
(4K x 1, 16 pin, Dynamic RAM)	
5208 (equiv. 2107)	£3.21
(4K x 1, 22 pin, Dynamic RAM)	
4116 (16K x 1, Dynamic RAM)	£18.00
2708 (1K x 8 UVEPROM)	£7.87
8080A (CPU)	£7.45
81LS95 (Buffer TriS)	75p
81LS96 (Buffer TriS)	75p

All VAT inclusive

35p for p&p orders under £5

Please write for discounts over 100 pieces

PET CORNER

Lotus now carry an exciting range of products for your CBM PET.

24K Memory Expansion

- ★ Mounts inside PET
- ★ Runs from PET's own power supply
- ★ Takes 10 minutes to fit
- ★ Includes memory test program
- ★ 6 month warranty

£399 inc. VAT & P&P

MUSIC BOX

Turns your PET into a program-mable musical instrument. You can record and play up to 90 pages, 16 notes per page, change tempo, key, etc.

£37.50 inc. VAT & P&P

T.I.S. WORKBOOKS

A set of 5 workbooks to give you a full understanding of all the ins and outs of your PET more fully than any previous manuals.

£15.95 per set. inc. P&P

Dustcover £17.95 inc. VAT & P&P

Lots of software and other goodies. Send large SAE.

LOTUS

The Age of Affordable Personal Computing Has Finally Arrived

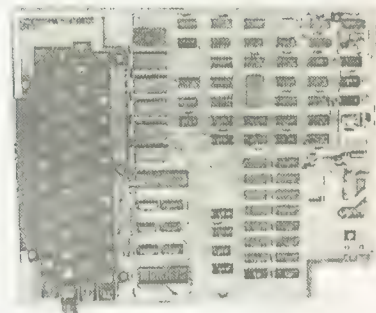
Ohio Scientifics

Superboard II

Full 8K basic and 4K user RAM
Built and tested

£284.95

inc. VAT & P&P



Ohio Scientific has made a major breakthrough in small computer technology which dramatically reduces the cost of personal computers. By use of custom LSI micro circuits, we have managed to put a complete ultra high performance computer and all necessary interfaces, including the keyboard and power supply, on a single printed circuit board. This new computer actually has more features and higher performance than some home or personal computers that are selling today for up to \$2000. It is more powerful than computer systems which cost over \$20,000 in the early 1970's.

This new machine can entertain your whole family with spectacular video games and cartoons, made possible by its ultra high resolution graphics and fast BASIC. It can help you with your personal finances and budget planning, made possible by its decimal arithmetic ability and cassette data storage capabilities. It can assist you in school or industry as an ultra powerful scientific calculator, made possible by its advanced scientific math functions and built-in "immediate" mode which allows complex problem

solving without programming! This computer can actually entertain your children while it educates them in topics ranging from naming the President of the United States to tutoring trigonometry all possible by its fast extended BASIC graphics and data storage ability.

The machine can be economically expanded to assist in your business, remotely control your home, communicate with other computers and perform many of the other tasks via the broadest lines of expansion accessories in the microcomputer industry.

This machine is super easy to use because it communicates naturally in BASIC, an English-like programming language. So you can easily instruct it or program it to do whatever you want, *but you don't have to*. You don't because it comes with a complete software library on cassette including programmes for each application stated above. Ohio Scientific also offers you hundreds of inexpensive programs on ready-to-run cassettes. Program it yourself or just enjoy it, the choice is yours.

Standard Features

- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
- Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers.
- 4K static RAM on board expandable to 8K
- Full 53-key keyboard with upper-lower case and user programmability
- Kansas City standard audio cassette interface for high reliability
- Full machine code monitor and I/O utilities in ROM
- Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 by 256 points. Normal TV's with overscan display about 24 rows of 24 characters, without overscan up to 30 x 30 characters.

Extras

- Available expander board features 24K static RAM (additional mini-floppy interface, port adapter for printer and modem and OSI 48 line expansion interface).
- Assembler/editor and extended machine code monitor available.

Commands

CONT	LIST	NEW	NULL	RUN
Statements				
CLEAR	DATA	DEF	DIM	END
GOTO	GOSUB	IF...GOTO	IF...THEN	INPUT
NEXT	ON...GOTO	ON...GOSUB	POKE	PRINT
REM	RESTORE	RETURN	STOP	READ

Expressions

Operators

—, +, *, /, ↑, NOT, AND, OR, >, <, <>, >=, <=, =
RANGE 10⁻³² to 10⁺³²

Functions

ABS(X)	ATN(X)	COS(X)	EXP(X)	FRE(X)	INT(X)
LOG(X)	PEEK(I)	POS(I)	RND(X)	SGN(X)	SIN(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)	USR(I)	

String Functions

ASC(X\$)	CHR\$(I)	FRE(X\$)	LEFT\$(X\$,I)	LEN(X\$)	MID\$(X\$,I,J)
RIGHT\$(X\$,I)			STR\$(X)		VAL(X\$)

Plus variables, arrays and good editing facilities.

Fully built and tested. Requires only +5V at 3 amps and a videomonitor or TV and RF converter to be up and running.

At this price there is going to be an enormous demand for Superboard II and supplies are going to be extremely limited. Lotus Sound is expecting first deliveries from the States in mid-December and orders will be treated strictly in the order they arrive, so post off today if you want to avoid long delays.

SOUND

4 MORGAN ST., LONDON E3 5AB

(Mail Order only)

To: LOTUS SOUND
4 MORGAN ST., LONDON E3 5AB

Please send me Ohio Scientific Superboard Computer(s)

I enclose cheque/PO for £

Name

Address

ETI 12



56-STATION ASCII KEYBOARD NOW IN STOCK — ASCII KEYBOARD MODEL KB756

Full 128 character set with ROM encoder (Upper and lower case + control shift).
Fully TTL-compatible—power requirements +5v-12v.
Supplied with full technical data, code chart, pin connections, circuit diagram and application notes.



**FANTASTIC
VALUE AT £60**

+ £1.50 p&p + 8% VAT (mail order total £66.42)

SELF-SCAN ALPHANUMERIC PANEL DISPLAY

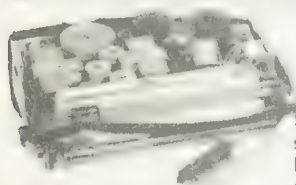
16/18 position display with 64 character repertoire, 5 x 7 dot matrix. Input 6-bit BCD-code, power requirements +5v, -12v. Character size 0.40" x 0.28". Overall dimensions 8 1/4" x 2 1/4" x 1 1/4". Supplied with full technical data. Price £55.00 + 75p P&P + 8% VAT (Mail order total £60.21).

BALL MIRATEL VIDEO MONITOR

9" diagonal P4 phosphor tube. Bandwidth 12 MHz (1.3dB). Input voltage 220V 50/60 Hz 24W. Output voltage +15V DC (short circuit protected) +12kV DC; 12.6V rms. Supplied complete with high & low voltage power supplies, amplifier, and attractive moulded plastic housing including space for keyboard. Price £95.00 + carriage + VAT.

SPECIAL PURCHASE — MITE

123P Alphanumeric printer mechanisms



**BRAND NEW SURPLUS
ONLY £75**

+ £3.50 P & P + 8% VAT
(Mail order total £84.78)

Solenoid-operated page printer using standard reversible typewriter ribbon. Prints standard 64-ASCII character set on 8 1/2" paper (80 characters per line, 6 lines to the inch). Maximum speed 11 cps. Power requirements 115VDC. Compact, light weight unit 9 1/4 lbs. 12" x 9" x 2 1/4" Supplied complete with full technical manual.

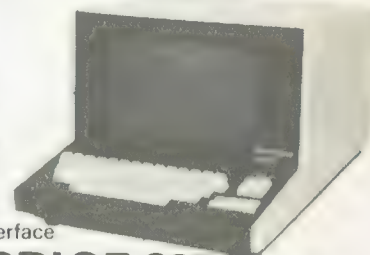
We also specialise in: DEC minis - PDP8 and PDP11 processors, add-on memory, peripherals and spares. Hard copy terminals ASR 33 and KSR 33 Teletypes, Data Dynamics 390, Texas Silent 700. Send for complete lists.



ELECTRONIC BROKERS LTD.
49-53 Pancras Road, London NW1 2QB.
Tel: 01-837 7781. Telex: 298694.

HAZELTINE VISUAL DISPLAY UNIT

- * Teletype Compatible
- * 12" Diagonal Screen
- * TTY Format Keyboard
- * 12 lines of 80 characters
- * 64 ASCII Character Set
- * 5 x 7 Dot Matrix
- * Switch-selectable Transmission Speeds up to 9600 baud
- * Switch-selectable Parity
- * Standard CCITT V.24 Interface



MODEL H-1000 PRICE £350 + carriage and VAT

Also available:—

Model H-1200: Specification as for H-1000 except 24 lines of 80 characters displayed. Price £425.00 + carriage + VAT.

Model H-2000: Buffered/Editing model with direct cursor addressing, dual intensity video, and detachable keyboard with separate numeric and edit clusters. 27 lines of 74 characters. Price £495.00 + carriage + VAT.

A copy of trading conditions supplied on request.

A more interesting way to learn



what is a microprocessor?

If you are considering buying a Micro-computer, Development System, or just want to learn more about this exciting technology, then this short introduction to Microprocessors is for you. Comprising of a 72-page book keyed to over two hours of cassette tapes the many aspects of Microprocessors are explained, including Binary and Hexadecimal counting. Internal structure. Operation. Programming Techniques. Devising a program., etc. Learn at your own pace with this valuable addition to your reference library.

To Technical Book Services
P.O. Box 79
Maidenhead, Berks SL6 2EG

ORDER FORM

Please send me.....copy/copies of What is a microprocessor?
@£10.75 each inclusive. I enclose remittance £.....

Name
(Print Please)

Address

Registered office 21, Mincing Lane, London EC1 Registered No 12225

EPROM Programmer

Program your own 2708 EPROMS by connecting this project up to your systems serial port.

MOST HOBBYISTS now use EPROMs (Eraseable PROMs) of the 2708 type for the various firmware in their systems. 2708s are not now as expensive as they used to be, and have the advantage of allowing you to correct those inevitable bugs in your own programs or reuse the EPROM for some completely different program.

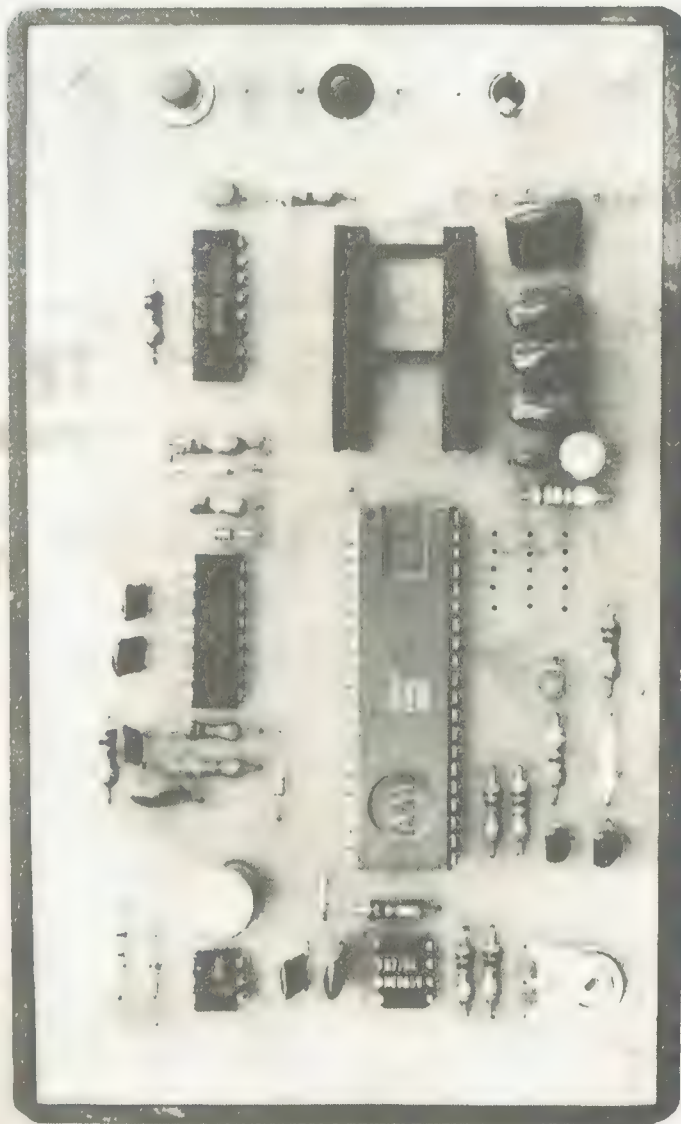
That's all very well, I hear you say, but I don't have a way of programming 2708s. Plus, commercial EPROM programmers are too expensive for me to justify since I only program one EPROM a month. Thanks to reader N. D. Hammond (and of course ETI) your troubles are over. Here is an inexpensive, nay, cheap, 2708 programmer suitable for individuals or impecunious clubs.

The programmer is, in fact, slightly different from the original design submitted to us by Mr Hammond; we have replaced some TTL in his design with CMOS and added a data time-out synchronisation facility, on which more later.

Design Features

The objectives of the original design were simplicity of construction and operation, and low cost. Another requirement which must be met is simplicity and versatility of interfacing — one of our bigger headaches is the fact that everyone's system seems to be different.

This project meets these objectives very well. The interface to the user's computer is *serial*, i.e. through a 20 mA current loop. As a bonus, the UART and a couple of one-shots provide all the necessary timing signals, so the component count is low and cost is low.



A useful by-product of our switch to a completely CMOS design was a spare gate, which we put to good use in providing a 'synchronisation' facility. The idea is that if a supply glitch or noise causes the UART to miss a byte of data, so that the 2708 addressing is out of step with the desired addressing, a $\frac{1}{4}$ second pause at the end of each cycle will reset the 4040 to zero. This means that only that cycle will be affected and subsequent cycles will be correct, increasing the programmer's tolerance to glitches.

There is one slight penalty that has to be paid — at 300 baud, it will take about 70 minutes to output all 1024 addresses 125 times. This is by no means brilliantly fast compared to the theoretical minimum programming time of 104 seconds but it is a lot better than the several days that would be required by a commercial firm.

Mr Hammond originally supplied software for the 8080, but our tests of the circuit were done on a MEK6800D2, for which we have written a routine, reproduced here. Our routine incorporates a time delay of approximately $\frac{1}{4}$ second at the end of each run through the 2708 addresses, in order to take advantage of the time-out synchronisation feature. Mr Hammond's 8080 program does not include this facility, but it is easy to add a time delay loop which decrements (say) the BC pair using the DCX instruction. We hope to give this program next month (so much to do, so little time, sigh!), but Mr Hammond's routine should work with no modification.

Adjustment

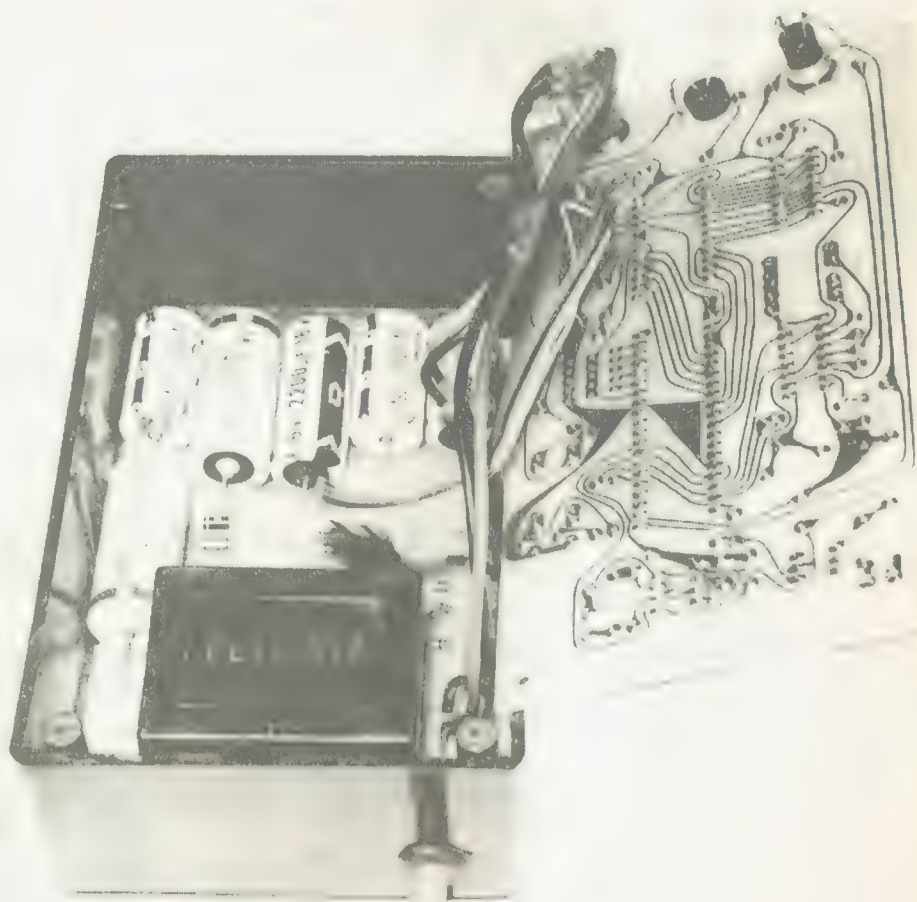
Before adjusting the oscillator frequency first fit the links which set the start-stop bit arrangement of UART.

Now with power connected adjust RV1 until IC2 is operating at 4800 Hz.

The 2708

At this point we digress to describe the 2708 and the steps involved in using and programming it.

The device is a static 8192 bit EPROM organised as 1024 x 8. It is packaged in a 24 pin DIP with a



quartz window which allows the data stored in the memory to be erased by exposure to ultra-violet light.

Reading the device is quite straightforward. The appropriate address is applied at the ten address pins, the chip select pin is taken low and after the appropriate access time (120ns from CS or 450ns from address select) the data is available at the eight output pins.

Fortunately, and in contrast to its predecessors, the 2708 is also simple to program. The chip select pin is taken to the 'write enable' level of +12 V and the applied address is cycled from 000H to 3FFH with the appropriate data applied at each address. After the data and address lines have settled at each address, a 26 V pulse of 0.1 ms to 1 ms duration is applied at the programming pin. The entire cycle of 1024 addresses is repeated until each address has received a minimum of 100 ms program pulse time.

Erasure is the simplest operation of all. The window is uncovered and the chip placed an inch or so away from an ultra violet tube. After half an hour or so, the memory is fully erased (to all '1's) and is ready for re-programming.

Operation

A fully erased EPROM has every bit set to the '1' state. Programming sets selected bits to '0'. It follows that a 2708 can be reprogrammed without erasing if there are no cases where a bit must be changed from '0' to '1', otherwise the device must be erased by exposure to ultra violet light. Any 'germicidal' UV tube is suitable for erasing. The chip(s) should be placed about an inch or so from the tube and left for at least half an hour to ensure complete erasure.

To program the device, the pattern to be written should be available in RAM. The programmer

EPROM Programmer

Parts List

Main board

RESISTORS

(All 1/2W 5%)

R1,17 180R

R2,3,6,11,13,15 10k

R4,5,12 1k

R7 4M7

R8 180k

R9 100k

R10 470R

R14 33k

R16 47R

POTENTIOMETER

RV1 25k

CAPACITORS

C1 8n 2 polyester

C2-C4,6,7 10n polyester

C5 33n polyester

C8,9,11,12 100n polyester

C10 100u 25V electrolytic

C13 10u 35V electrolytic

SEMICONDUCTORS

IC1 4N33 Opto coupler

IC2 555

IC3 MM5303 UART

IC4 4049

IC5 4040

Q1 PN3638

Q2 BC548

Q3 BC558

Q4 BC548

D1-D4 1N914

LED1

MISCELLANEOUS

PCB as pattern

24 pin IC socket

Push button

Plastic box 158x96x50mm

Parts List

RESISTORS

(All 1/2W 5%)

R1 1k

R2,3 120R

R4,5 47R

R6 470R

R7 100R

CAPACITORS

C1,6 470u 50V electrolytic

C2 2200u 16V electrolytic

C3-C5 1000u 25V electrolytic

DIODES

D1-D6 1N4004

ZD1 27V 1W

ZD2 12V 400mW

ZD3 12V 1W

ZD4 5.1V 400mW

ZD5 5.1V 1W

MISCELLANEOUS

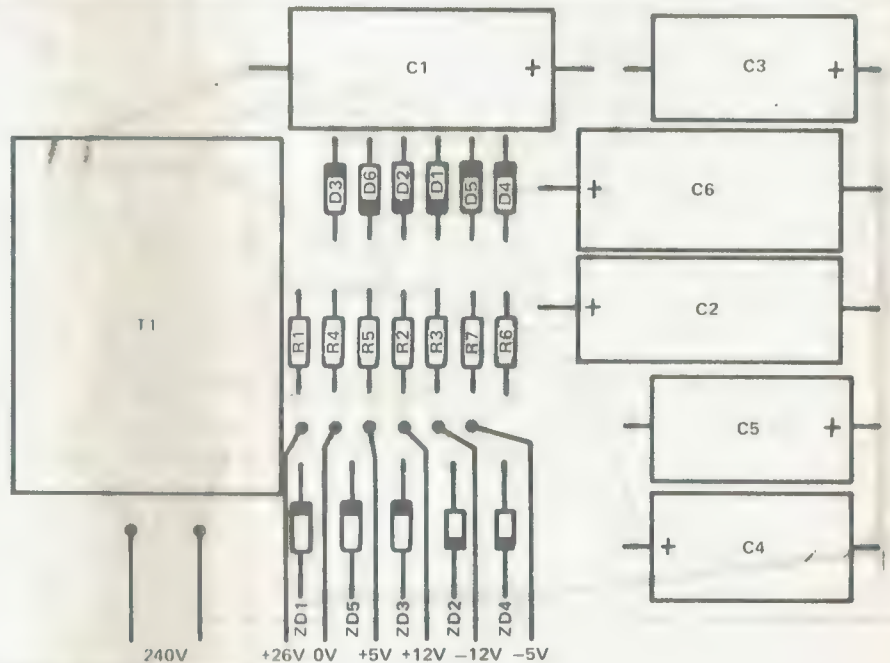
PCB as pattern

Transformer PL15-5VA

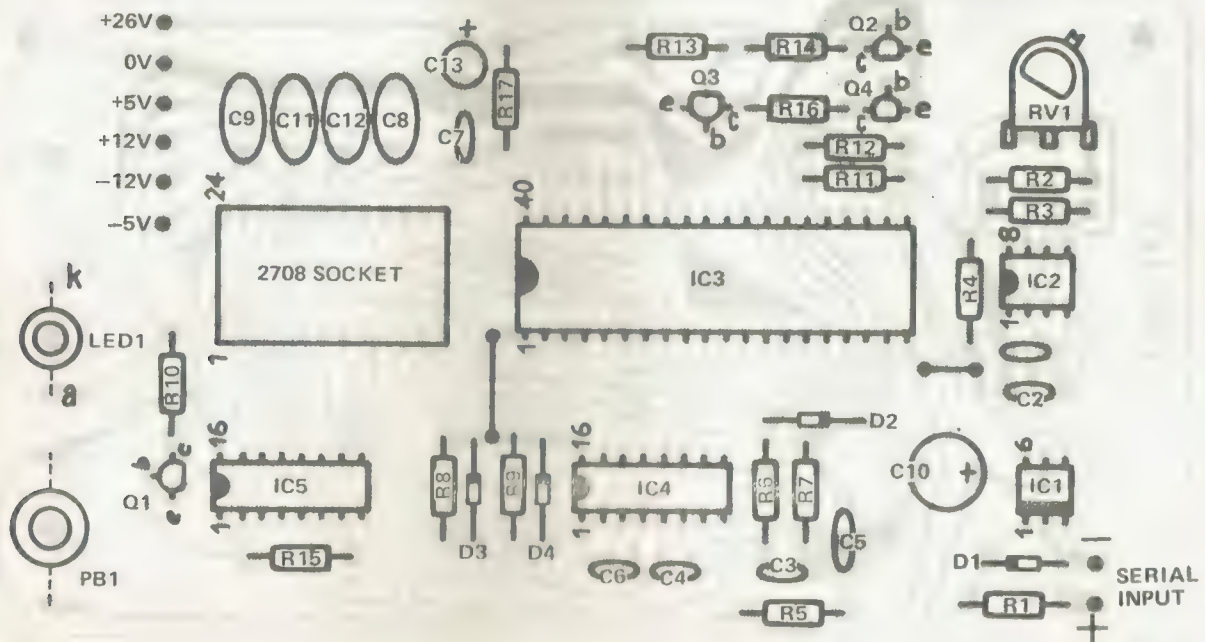
Switch DPDT toggle

3 core flex & plug

Cable clamp



Overlay for the programmer main boards.



times. In practice, this should be increased by 25% or so to allow for the effects of component tolerances.

Use of the UART considerably simplifies the software requirements of the system which will drive the programmer, all that is necessary is a program which will output the required memory contents in order and repeat this for the required number of times.



The power indicator LED is driven by one of the outputs of IC5 and is turned on and off quickly indicating data is being received.

```

***** INTERFACE PROGRAM FOR 2708 EPROM PROGRAMMER *****

PAGESTART: EQU 04H      HIGH ORDER BYTE OF RAM ADDRESS
                  TO BE LOW ORDER EPROM ADDRESS
NEXTPAGE: EQU 08H      ZERO LOW ORDER EPROM ADDRESS
CTRL: EQU 0             HIGH ORDER BYTE OF PAGESET ZERO
DATA: EQU 1             ADDRESS OF I/O STATUS & CONTROL PORT
                          ADDRESS OF I/O DATA PORT

INITIALIZATION - NOTE: SYSTEM DEPENDENT THIS SEGMENT WRITTEN
FOR AN INTEL 8251 SERIAL I/O PORT

MVI A, 4EH
OUT CTRL
MVI A, 11H
OUT CTRL

```

[illegible]

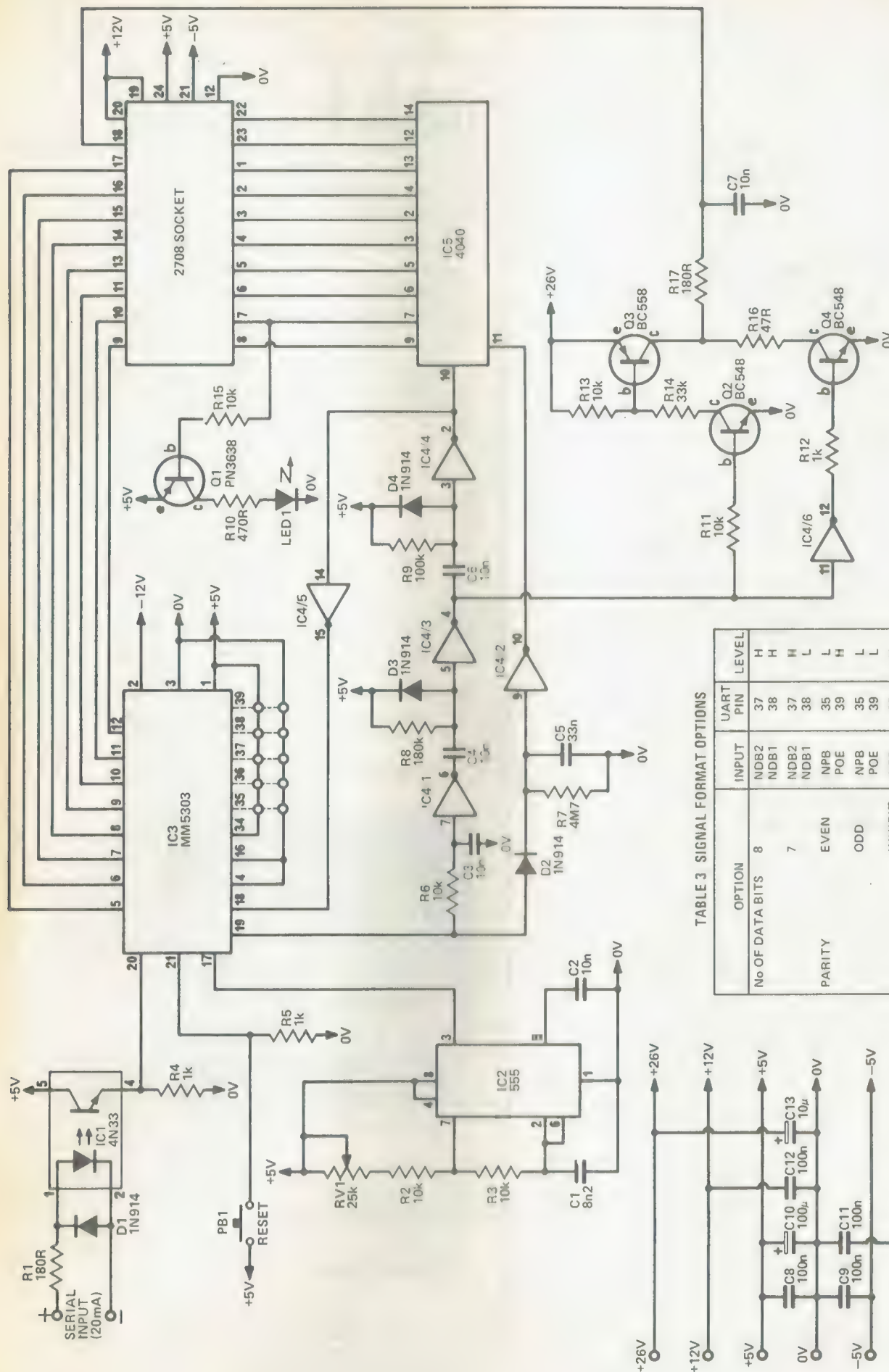


TABLE 3 SIGNAL FORMAT OPTIONS

OPTION	INPUT	UART PIN	LEVEL
No OF DATA BITS 8	7	NDB2	H
		NDB1	H
		NDB2	H
		NDB1	L
PARITY	EVEN	NPB	L
		POE	H
		NPB	L
		POE	L
INHIBIT	ODD	NPB	L
		POE	L
		NPB	H
		POE	X
No OF STOP BITS	1	NSB	L
	2	NSB	H

H=HIGH (+5V) L=LOW (0V) X=DON'T CARE

Construction

We built our prototype into a plastic box with the power supply on one board in the box itself while the logic board was used in place of the lid.

These boards should be assembled according to the overlays provided. Normal handling procedures should be taken with the CMOS ICs and the UART. A good quality socket should be used for the EPROM as it will be used a lot. The pushbutton, LED and power switch are mounted on the logic board and connected from the rear.

With the power switch, due to the closeness of the capacitors on the lower board, the wires should be taken parallel to the PCB and the rear of the switch epoxied over to give protection. The connection between the power supply and logic board can be done with a piece of ribbon cable as the connections follow the same sequence.

We used PC pins for the data input points but a socket could be used if desired.

The PCB patterns for this project can be obtained by sending an SAE to Computing Today, 25-27 Oxford Street, London, W1R 1RF. Mark the envelope EPROM foils.

TABLE 1. 6800 EPROM DRIVER FOR D2

6800 EPROM PROGRAMMER DRIVER FOR D2

	OUTCH	EQU	E37A
	PAGESTART	EQU	04
	NEXTPAGE	EQU	08
	ACIAS	EQU	8008
; INITIALISATION OF ACIA			
0000	86 55		LDA A # %0101001
0002	B7 80 08		STA A
; MAIN PROGRAM			
0005	C6 7D		LDA B 125
0007	CE 00 00	NEWCYCLE:	LDX PAGESTART
000A	A6 00	NEXTBYTE:	LDA A, X
000C	BD E3 7A		JSR OUTCH
000F	08		INX*
0010	8C 04 00		CPX NEXTPAGE
0013	26 F5		BNE NEXTBYTE
0015	36		PSH A
0016	37		PSH B
0017	86 FF		LDA A \$FF
0019	C6 FF		LDA B \$FF
001B	5A	LOOP:	DEC B
001C	26 FD		BNE LOOP
001E	4A		DEC A
001F	26 FA		BNE LOOP
0021	33		PUL B
0022	32		PUL A
0023	5A		DEC B
0024	26 E1		BNE NEWCYCLE
0026	3F		SWI

For Test:

000A 86 XX NEXTBYTE: LDA A XX
outputs ASCII character XX

or

000A 4C NEXTBYTE: INC A
000B 01 NOP

outputs incrementing characters.

IN SCOTLAND

IN SCOTLAND

NASCOM 1

Z80 Microcomputer kit

Undoubtedly the finest value for money kit available anywhere. Fully socketed.

INTERFACE FOR:

TV (UHF)
TV Monitor
Cassette
Teletype
32k Ram expansion board

May be seen working
9 a.m. - 5 p.m. Mon.-Fri.

Callers welcome

Price £197.50 + VAT (8%)

Callers welcome



STRATHAND
44 ST. ANDREW'S SQ.
GLASGOW G1 5PL
041-552 6731

Callers welcome



Tel. order welcome with Access and Barclaycard

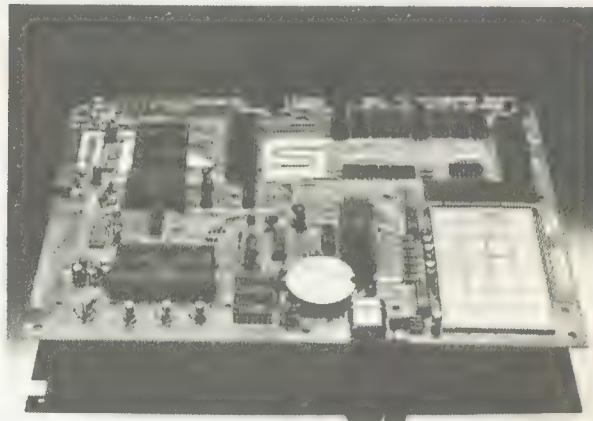


NEWBEAR COMPUTING



Announcing the SYM-1:-from Synertek

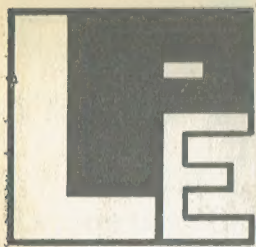
(formerly VIM-1)



- ★ Fully assembled and tested
- ★ K1 M.I. compatible.
- ★ High speed cassette interface (2400 baud)
- ★ 1K byte storage, expandable on board to 3K byte
- ★ 4K byte ROM Monitor
- ★ Fully expandable and much much more

£199.00 plus 8% VAT £1.00 postage and packing

For further details Visit Newbear Computing Store, 2 Gatley Road, Cheadle, Cheshire, 061-491 2290. Or visit, or write to: Newbear Computing Store, 7 Bone Lane, Newbury, Berks. 0635 49223. Send for Catalogues of Hardware Components, Literature and Software.



Room ETI/12
313 Kingston Road, Ilford
Essex IG1 1PJ, England
01-553 1001

L.P. ENTERPRISES

From the representatives in Europe ... for America's leading Micro-computer magazines and books, for the
hobbyist, educationist and professional alike, we bring you a little light browsing!

Reading maketh a full man ... Francis Bacon (1561-1626)

Tick or indicate quantity ordered.		Price UK	Price Overseas If Different
From Adam Osborne Associates			
INTRODUCTION TO MICROCOMPUTERS			
Volume 0: The Beginners Book		£5.95	
Volume 1: Basic Concepts		£5.95	
Volume 2: Some Real Products (Revised Late 1977)		£11.95	
6800 Programming for Logic Design		£5.95	
8080 Programming for Logic Design		£5.95	
Z80 Programming for Logic Design		£5.95	
8080A/8085 Assembly Language Programming		£6.95	
6800 Assembler Language Programming		£6.95	
Some Common BASIC Programs		£5.95	
BUSINESS PROGRAMS IN BASIC			
Payroll With Cost Accounting		£9.95	
Accounts Payable & Accounts Receivable		£9.95	
General Ledger (Available from late summer 78)		£9.95	
From Scelbi Computer Consulting Inc.			
6800 Software Gourmet Guide & Cookbook		£7.95	
8080 Software Gourmet Guide & Cookbook		£7.95	
8080 Programmers Pocket Guide		£2.25	
8080 Hex Code Card		£2.25	
8080 Octal Code Card		£2.25	
8080 Guide and One 8080 Code Card		£4.20	
8080 Guide and Both Code Cards		£6.00	
Understanding Microcomputers & Small Computer Systems		£7.95	
SCELBI 'BYTE' Primer		£9.95	
8080 Standard Assembler (In Block Format)		£15.95	
8080 Standard Editor (In Book Format)		£9.95	
8080 Standard Monitor (In Book Format)		£9.95	
From Peoples Computer Company			
Reference Books of Personal & Home Computing		£4.95	
What to Do After You Hit Return		£7.00	
Dr. Dobbs Journal Volume 1		£10.00	
*From Kilobaud/73 Magazine Inc.			
Hobby Computers Are Here		£3.95	
New Hobby Computers		£3.95	
From Dymax Inc.			
Instant BASIC by Jerald R. Brown		£4.95	
Your Home Computer by James White		£4.95	
My Computer Like Me ... When I Speak			
BASIC By Bob Albrecht		£1.65	
Games With A Pocket Calculator by			
Thiagarajan & Stilovitch		£1.75	
Games, Tricks and Puzzles For a Hand			
Calculator by W. Judd		£2.40	
*From BYTE Publications Inc.			
Paperbytes:			
Tiny Assembler for 6800 Systems		£5.75	
Bar Code Loader for 6800, 8080, Z80 & 6502 Micros		£1.75	
Best of Byte Volume 1		£8.95	
Tick or indicate quantity ordered		Price UK	Price Overseas If Different
* From Creative Computing Press			
Best of Creative Computing Volume 1		£6.95	
Best of Creative Computing Volume 2		£6.95	
BASIC Computer Games			
(A revised 101 BASIC Games)		£5.50	
The Colossal Computer Cartoon Book		£3.95	
Computer-Rage (A new Board Game)		£6.95	
Artist and Computer		£3.95	
* From Everyone Else			
Magazine storage boxes (hold 12 minimum)		£1.25	
Sybex: Microprocessors from Chips to Systems			
by R. Zacs		£7.95	
Sybex: Microprocessors Interfacing Techniques			
by R. Zacs		£7.95	
Dilithium: Home Computers			
Volume 1: Hardware		£6.50	
Dilithium: Home Computers			
Volume 2: Software		£5.95	
Getting Involved With Your Own Computer		£4.75	
The Z80 Microcomputer Handbook		£7.50	
TV Typewriter Cookbook by Don Lancaster		£7.50	
TTL Cookbook		£7.95	
CMOS Cookbook		£7.95	
IC Timer Cookbook		£7.50	
IC OP-AMP Cookbook		£9.50	
RTL Cookbook		£4.25	
Computer Programs that Work (in BASIC)		£2.55	
* From Basic Software Library			
(from Scientific Research Instruments)			
Vol 1: Business and Personal Booking Programs		£17.50	
Vol 2: Maths and Engineering Programs		£17.50	
Vol 3: Advanced Business Programs		£26.50	
Vol 4: General Purpose Programs		£7.95	
Vol 5: Experimenters Programs (General			
Purpose)		£7.95	
Vol 6: General Ledger Program		£32.50	
Vol 7: Professional Programs		£26.95	
Magazines: Back Issues			
Personal Computing		£1.75	
Interface Age		£2.25	
Dr. Dobbs Journal		£1.75	
Computer Music Journal		£2.50	
Peoples Computers		£1.75	
*BYTE		£2.25	
Creative Computing		£1.75	
Calculators & Computers		£1.75	
ROM		£1.75	
Kilobaud		£2.25	
73		£2.00	
MAGAZINES: Subscriptions			
Personal Computing (Twelve Issues Yearly)		£16.00	£17.00
Interface Age (Twelve Issues Yearly)		£20.00	£20.50
Dr. Dobbs Journal (Ten Issues Yearly)		£13.00	£13.50
Computer Music Journal (Four Issues Yearly)		£8.50	£9.00
Peoples Computers (Six Issues Yearly)		£8.00	£8.50
Kilobaud (Twelve Issues Yearly)		£20.00	£21.00
BYTE (Twelve Issues Yearly) via USA		£15.00	
BYTE (Twelve Issues Yearly) via UK		£21.00	
Creative Computing (Six Issues Yearly)		£8.50	£9.00
Creative Computing (Twelve Issues Yearly)		£16.00	£17.00
Calculators & Computers (Seven Issues Yearly)		£10.00	£10.50
73 (Twelve Issues Yearly)		£20.00	£21.00

HOW TO ORDER

Please note our prices include postage and packing, but not insurance, if wanted add 12p for every £10 of books ordered. Make cheques, PO's etc payable to

L.P. Enterprises

CREDIT CARDS accepted.
BARCLAYCARD VISA / ACCESS
DINERS CLUB / AMERICAN EXPRESS

Phone 01-553 1001 for Credit Card orders (24 hour service).

Due to fluctuations of the dollar, prices are subject to change

Send to address above for the attn. of David, Dept. ETI/12
Indicate Payment Method:

..... My cheque, P.O., I.M.O. is enclosed in Sterling on U.K. Bank

..... Charge to Barclaycard/Visa/Access/Diners/American Express

Credit Card No. Expiry date

Name

Address

All Orders must be Prepaid
Total Enclosed £

..... POSTCODE

Signature

All publications are published in U.S.A. and shipped air-freight by L.P. Enterprises. In unusual cases, processing may exceed 30 days
*BYTE subscriptions are processed IN USA and are air-freighted & posted from Amsterdam and will take 3 months to start.

ETI/12/78

U.K. Subscriptions start within three weeks
TRADE ENQUIRIES WELCOME

STUDENTS & TEACHERS

WITH YOUR ORDER, SEND PROOF OF YOUR STATUS AND RECEIVE 5% OF YOUR PRESENT ORDER AS A CREDIT CERTIFICATE YOU CAN USE ON YOUR NEXT ORDER.

FREE SOCKETS

WITH PURCHASE OF ANY OF THESE I.C.'s.

CHRISTMAS SPECIAL OF 5% OFF EFFECTIVE ON ALL ORDERS MAILED BEFORE DECEMBER 25, 1978.

THE FIRST MEMORY SPECIAL YOU WON'T FORGET

2102-2	650ns	8/9 ⁹⁵	32/37 ⁰⁰	64/71 ⁰⁰	128/135 ⁰⁰
2102-4	450ns	8/10 ⁹⁵	32/41 ⁰⁰	64/78 ⁰⁰	128/145 ⁰⁰
2114D	450ns	8/79 ⁰⁰	16/149 ⁰⁰	32/274 ⁰⁰	64/499 ⁰⁰

PRESCALER - 250 MHZ

complete \$23⁹⁵

PRESCALER - 650 MHZ

complete \$49⁹⁵

11C90 - PRESCALER CHIP

650 mc \$19⁹⁵

SOLID STATE RELAY

• 400 V at 3 AMPS • TTL COMPATIBLE
• MICRO REED ACTUATED TO MINIMIZE CHANCES OF AC POWER SPILLOVER INTO LOGIC CIRCUITS \$3⁹⁵

OPTO ISOLATORS

1. MCT2 \$.79
2. MOC1000 \$.89
3. 4N-26 \$.95
4. CL1422

CLAIREX PHOTO MODULE (USE AS VOLTAGE VARIABLE RESISTOR—40 MEG OHM TO 40 OHM—MILLION TO ONE RATIO—OR USE AS VERY HIGH VOLTAGE OPTO ISOLATOR) \$1⁴⁹

CHEAPER BY THE 100

LEDS- (HP AXIAL-RED)	100/8.95
LEDS- (MINI-RED)	100/9.95
LEDS- (JUMBO-RED)	100/13.95
LEDS- (DUAL COLOR)	100/59.00
1N4001- (50V-1 AMP)	100/ 4.95
1N4148- (SWITCHING DIODE)	100/ 3.95
2N4303- (N-JFET)	100/21.95
2N3392- (PRIME-NPN LOW NOISE)	100/ 9.95

AUDIO POWER AMPS

SINGLE

TDA-2020-20 Watt	\$9.95
S11020H-20 Watt	\$10.50
S11130H-30 Watt	\$12.50
STK-50 -50 Watt	\$18.95

STEREO

STK433-5 Watts per channel	\$6.95
STK435-7 Watts per channel	\$9.95
STK437-10 Watts per channel	\$11.95
STK439-15 Watts per channel	\$13.95
STK441-20 Watts per channel	\$16.95

8080 SYSTEM

8080A	5.95
8212	3.75
8214	8.95
8216	3.50
8224	4.80
8226	4.75
8228	7.25
8238	8.25
8251	9.45
8253	21.50
8255	10.75
8257	20.50
8259	20.50

Z-80 SYSTEM

3880	22.50
3881	12.50
3882	12.50
3883	49.00
3884	73.00

6800 SYSTEM

6800	16.95
6810	7.20
6820	7.95
6821	8.50
6850	8.95
6852	11.95
6860	9.95
6862	13.75

6500 SYSTEM

6502	14.95
6520	12.75
6522	12.50
6530	17.50

9900 SYSTEM

9900	66.00
9901	23.75
9902	19.50
9980	54.00
9981	54.00

1800 SYSTEM

1802	24.00
1821	19.50
1822	20.25
1824	13.50
1852	13.75
1856	11.75
1857	11.76
1861	20.00

CPU's

2650	19.95
2901	19.95
PAGE	19.00
SC/MP	14.95

CPU's cont.

8008	8.95
8035	19.95

RAM

7489	2.95
3101	3.95
8225	2.95
2101-1	2.95
2101-2	3.25
2101A-4	3.25
2102-2	1.50
2102L1	1.95
82S10	4.95
82S11	4.95
5101L-3	11.95
2107	3.95
TMS4060	3.95
UPD411	3.95
4200A	9.95
2114 200ns	13.50
2114 450ns	10.95
2114 650ns	6.25
4116 200ns	18.50
4116 300ns	17.50
4116 450ns	13.50

PROMS

8223	2.95
82S23	3.75
82S126	5.95
82S129	6.95
82S131	7.25
6306-1	6.95
93427	5.95
D3604	11.95
2616	50.00
1702A	4.95
2708	12.95
2716-5V	46.95

CHARACTER GENERATORS

2513 UC	7.95
2513 LC	7.95
2516	7.95
5240	7.95
MM6571A	9.95

KEYBOARD ENCODER

AYS-2376	14.95
----------	-------

UARTS

AYS-1012	8.95
AYS-1013	8.95
TR-1602	9.95
TMS6011	8.95

FIFO's

3341	7.95
1502E	10.95

PROG. LOGIC ARRAYS

82S100	11.95
82S101	11.95

SHIFT REGISTERS

C1402A	1.95
MM1403AH	1.95
MMS006AH	2.95
MMS060	3.95

CLOCK CHIPS

MMS311	7.95
MMS312	4.95
MMS313	7.95
MMS314	4.95
MMS315	7.95
MMS316	4.50
MMS375	5.95
TMS3834	6.95
CT7001	6.50

CALCULATOR CHIPS

MM5725	1.95
MM5736	1.95
MM5738	1.95
MM5739	1.95
MCS2521	1.95

INTERFACE CHIPS

DS0026	3.25
DS3608	3.85
DM8093	9.95
DM8094	9.95
DM8095	9.95
DM8096	9.95
DM8097	9.95
DM8098	9.95
DM8131	3.25
DM8202	1.45
DM8233	1.10
DM8234	1.10
DM8241	4.45
DM8242	4.45
DM8250	9.90
DM8251	9.90
DM8266	1.35
DM8267	1.35
DM8271	1.35
DM8544	1.30
DM8831	2.95
DM8833	2.60
DM8835	2.60
DM8836	4.75
DM8837	2.45
74273	2.60
74390	2.10
81LS95	1.95
81LS96	1.95
81LS97	1.95

S-100 MOTHER BOARD — 8 Slot Kit 69.00

S-100 32K STATIC MEMORY BOARD 599.00

ALL BURNED IN 450ns 735.00

AND TESTED 200ns 875.00

ultra low power 3.50

S-100 EDGE CARD CONNECTORS 19.95

MAXI KEYBOARD — 53 Keys 33.95

MAXI KEYBOARD — 74 Keys 1.95

KEYPAD — 16 key x-y matrixed 2.95

KEYPAD — 20 key x-y matrixed 2.95

WIRE WRAP POSTS 2 level 100/3.95 4 level 100/4.95

WIRE WRAP SOCKET PIN 100/7.95

TAPE READER — 12 level — includes both IR sources and pickups 29.00

MAKE YOUR OWN PAPER TAPE READER 10/9.50

1/10" SPACED PHOTO TRANSISTORS 1.89

REED RELAY — TTL compatible 3.95

SOLID STATE RELAY — micro reed actuated for total isolation 3.95

CRYSTAL FILTERS — 455 Kc miniature single section 1.95 dual section 2.95

PRECISION THERMISTORS

YSI BEAD — 1% 5000 OHM 2.95

GLASS BEAD — 1% 15000 OHM 2.95

CYLINDRICAL — 01% 200 OHM 3.95

POWER THERMISTOR — positive temperature coefficient 20-2500 OHM 2.95

D/A CONVERTER — NES008 (8 bit) 7.95

D/A CONVERTER — DAC 01 SH (6 bit) 6.95

PHOTO DIODE — super fast 0.5ns 3.95

IR DETECTOR — super sensitive 4.95

READ OUTS — MULTI DIGIT

LCD-3-1/2 dig. 4"-4.95 3-1/2 dig. 3" 1.95

LED-17"-3 dig. 1.25 — 6 dig. 3.95 — 8 dig. 4.95

PHOTO DEVICES—DIODES, XSTR's, DARLINGTONS

2N5771-1.25 FPT100A 79 MD1 1.95

H-38 -3.25 MRD-250 1.95 LASCR 1.95

HIGH VOLTAGE TRANSISTORS

2SC1358 100W 1400V 5A TO-3 7.95

BUY69B 110W 800V 10A TO-3 5.95

W905 100W 500V 5A Plastic 4.95

362-4 20W 500V 1A Plastic 2.25

338-7 20W 350V 1A Plastic 1.50

HIGH VOLTAGE DIODES

UNMARKED 1500V at 1 AMP 10/1.99

EG 250 2500V at 35 AMP 9.95

HV60EL 6000V at 25 ma 1.95

SUBMINIATURE 20,000V at 100 ma 2.95

CARBIDE DRILL BITS AND ROUTER BITS for P.C. board work — MIXED SIZES

OUR MIX — DRILLS 10/12.95 100/95.00

OUR MIX — ROUTERS 10/15.95 100/125.00

RADIO SHACK®

TRS-80™ COMPUTER

SERVICE AND MODIFICATION

BE FIRST TO TURN YOUR TRS-80 INTO A SUPER MACHINE

1. Keyboard and Video Mod

ADD RAM FOR LOWER CASE CHARACTERS AND CLEAN UP HORIZONTAL SMEAR (SEND YOUR TRS-80 MICROCOMPUTER ONLY)

PARTS AND LABOR \$59⁰⁰

2. Install 16K Memory

JUST SEND US YOUR TRS-80 MICROCOMPUTER AND WE DO THE REST.

16K OF MEMORY AND LABOR \$189⁰⁰

3. Level 2 plus 1 Mod

WE INSTALL YOUR LEVEL 2 SO YOU KEEP LEVEL 1 AND CAN USE IT BY JUST FLIPPING A SWITCH. (SEND LEVEL 2 WITH YOUR TRS-80)

\$69⁰⁰

4. Clock Mod

INCREASE YOUR PROCESSING SPEED BY 30%. WITH THIS OPTION YOU CAN SWITCH-SELECT BETWEEN THE FASTER 2.66MHZ CLOCK RATE AND 1.77MHZ.

INSTALLATION, PARTS AND LABOR \$49⁰⁰

5. Serial Printer Interface Mod

OPERATE CRYSTAL CONTROLLED TTY WITH LEVEL 1 OR 2. WE INSTALL SWITCH SELECTABLE BAUD RATES OF 75, 110, 137.5, 150, 300, 600, 1200, 2400, 4800, 9600 OR EXTERNAL EIA RS232 AND CURRENT LOOP OUTPUT.

PARTS AND LABOR \$119⁰⁰

6. Mini Floppy Mod

YOU PROVIDE EXPANSION INTERFACE AND WE'LL INSTALL A PERTEC F D 200 MINI FLOPPY.

PARTS AND LABOR (PERTEC F D 200 MINI FLOPPY INCLUDED) FOR ONLY \$425⁰⁰

SPECIALS!! DO MORE THAN ONE MOD AND SAVE

MODS 1, 2, 3, 4 AND 5	\$449 ⁰⁰
MODS 1 AND 2	\$234 ⁰⁰
MODS 2 AND 3	\$243 ⁰⁰
16K MEMORY, PARTS AND INSTALLATION DATA	\$159 ⁰⁰

SEND TRS-80 KEYBOARD ONLY!!

RETURN SHIPPING:
FROM ENGLAND ADD \$30.00 FOR AIR, \$9.50 SURFACE MAIL
FROM JAPAN ADD \$35.00 FOR AIR, \$8.50 SURFACE MAIL

REPAIR—WE WILL REPAIR ANY ORIGINAL TRS-80 MICROCOMPUTER OR ONE OF OUR MODIFICATIONS.

ALL PARTS AND LABOR \$69⁰⁰

NOTE: THIS IS AN INDEPENDENT SERVICE EFFORT NOT AFFILIATED WITH RADIO SHACK® OR TANDY CORPORATION.

ALL WORK GUARANTEED UNCONDITIONALLY FOR 1 YEAR

TERMS FOR TRS-80 WORK: WE ACCEPT ONLY TRS-80 MICROCOMPUTERS! SHIP YOUR TRS-80 MICROCOMPUTER TO US, INSURED AND SUITABLY PACKAGED AND WE WILL RETURN SAME FREIGHT COLLECT. ALL FACTORY SEALS MUST BE INTACT. ANY UNIT WHOSE SEALS HAVE BEEN TAMPERED WITH WILL BE SHIPPED BACK IMMEDIATELY. MODS 1, 2, 4 AND 5 SEND TRS-80 MICROCOMPUTER ONLY. MOD 3 SEND YOUR TRS-80 MICROCOMPUTER AND LEVEL 2. MOD 6 SEND TRS-80 AND EXPANSION INTERFACE. NORMAL TURN AROUND TIME IS UNDER 10 DAYS WITH CERTIFIED FUNDS

F. REICHERT SALES

DROP INTO ONE OF OUR LOCATIONS

1110 E. GARVEY AVE.
W. COVINA, CA 91790
(213) 967-3846

- \$20 MINIMUM ORDER
- FREE UPS DELIVERY ON U.S. ORDERS ONLY—OR BY SURFACE MAIL IF SPECIFIED.
- MONEY BACK GUARANTEE (MOS & LED DEVICES EXCLUDED)
- UNDER 8 HOUR PROCESSING ON MONEY ORDERS & CASHIER'S CHECK.

- SORRY! NO CDD'S, P.O.'S OR CREDIT

Softspot

The start of a regular software section in Computing Today this month. To start the ball rolling we present a game, designed to run on the TRITON, written by Don Scales. This section will not be restricted to BASIC programs however we want to publish machine code routines, even programming hints.

Send any software you have to Computing Today, 25-27 Oxford Street, London, W1R 1RF.

MISSILE (1K)

Missile is a game which utilizes the graphics and memory mapping features available to the TRITON.

The object of the game is to shoot down each enemy aircraft before it gets past your defences (across the screen). To do this you command three missile sites.

Unfortunately, your radar station has been knocked out and the aircraft can come in at any height between 1 and 16 miles high.

The missile stations are sited at 16, 32 and 48 miles from the coast (left edge of the screen). Both the aircraft at 8 miles high, station 1 must fire with a delay of 8 seconds.

There are 10 aircraft coming in and before each, you must set the missile fuses by specifying the time delay before ignition.

Good Luck.

```

10 N=0
20 FOR J=1 TO 10
30 @ (2)=976, @ (5)=992, @ (8)=1008
40 @ (3)=976, @ (6)=992, @ (9)=1008
50 PRINT 'MISSILE'
60 INPUT '1ST' @ (1), '2ND' @ (4), '3RD' @ (7)
70 VDU 0, 12
80 FOR I=1 TO 150; NEXT I
90 Y=(RDN (16) - 1) * 61, Z=1
100 FOR X=1 TO 64
110 VDU 2, 32
120 W=Y+X
130 VDU W, 62
140 Z=W
150 FOR I=1 TO 7 STEP 3
160 IF X < @ (1) GOTO 250
170 VDU @ (1+2), 32
180 IF @ (I+1) < 1 GOTO 250
190 VDU @ (I+1), 94
200 @ (I+2)= @ (I+1)
210 @ (I+1)= @ (I+1) - 64
220 IF @ (I+2)=W GOTO 400
250 NEXT I
300 NEXT X
310 GOTO 500
400 VDU W, 42
410 N=N+1
500 NEXT J
510 PRINT 'HITS', N
    
```

COMPUTING TODAY — DECEMBER 1978

The exciting new
Triton computer from

electronics today
international



The first British-designed home computer kit with basic IN ROM and graphics. The single-board design makes the computer easy to construct and when complete, a very compact and powerful tool for home, educational and industrial use.

ADD A STANDARD domestic TV set and a cassette recorder to the TRITON and you have a complete home computing system that is equal to, indeed in some areas superior to, many of the commercial ready built systems now on the market.

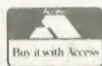
The TRITON has been designed on a single board, which means that construction should not pose any problems providing an adequate standard of soldering is maintained throughout. The case, designed specifically for the TRITON, means that the finished unit can safely and attractively be housed. In use, with the TV set on top of the case, the TRITON will be easy and convenient to operate.

The TRITON is based on the 8080 MPU, a device which has proven itself over a number of years. This MPU has a vast amount of software available for it and the TRITON'S 1K monitor system allows for easy entry and subsequent modification of such material.

The 2K TINY BASIC that is also resident in the TRITON, allows this popular, easy to learn, language to be used in conjunction with the TRITON's versatile graphic character set and unique VDU function to develop everything from games to education programmes quickly and easily.

The TRITON has space for 3K of user RAM on board but the machine has been designed in order to make expansion a simple matter.

Complete kit available immediately for only



£286

+ 8% VAT
POST PAID

All components can be bought separately. Send s.a.e. 12½p for full parts and price list. Triton manual is available for £5 (free with kit).

HENRY'S
RADIO

All mail to: Henry's Radio
404 Edgware Rd. London W2
PHONE (01)723 1008

INTERESTED IN HOME COMPUTING?

nm
Nascom Microcomputers

Start now and don't get left behind
THE NASCOM 1 is here
Ex-stock with full technical services

**BLANK C12
Racal Quality
CASSETTES
£4.00 for 10**

Plus the opportunity to join the fastest moving club of personal computer users enabling you to get the most out of your computer. You can OBTAIN and EXCHANGE programs and other software - many now available.

The Powerful Z80
Microprocessor
Professional Keyboard
1 Kbyte Monitor in EPROM
2 Kbyte RAM (expandable)
Audio Cassette interface
Plugs into your domestic TV

Easy construction from
straightforward instructions
no drilling or special tools
Just neat soldering
required.



Only **£197.50** + 8% VAT (includes p & p + insurance)

Manuals separately 3.50
Z80 programming Manual 6.90
Z80 Technical Manual 3.40
PIO Technical Manual 3.40
(All prices add 8% VAT)

**MONITOR QUALITY
IMPROVED TV
MODULATOR 2.50**
Power supply suitable for
NASCOM 19.90

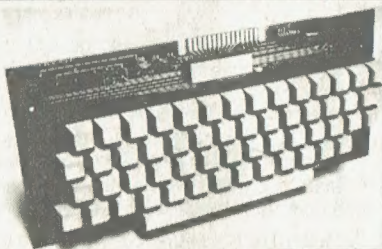
NASCOM EXPANSION Our customers will be informed within 24 hours when we receive Nascom expansion boards.

KEY BOARD

Brand new professional
ASCII keyboards (USA)
Full technical details
included.

Only **£49.90**
+ 8% VAT.

Ready built, tested
and guaranteed.

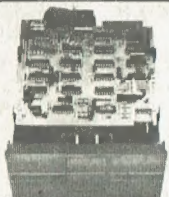


NEW- AVAILABLE NOW

\$100 BUS

Shugart mini floppy drives **£290** each

Floppy drive controller
direct from USA **£250** each



A LAST- A COMPUTER JOYSTICK

Complete with hardware which neatly packs into a stylish plastic Joy Stick Case plugging directly into your Nascom PIO Port with no extras. FULL DOCUMENTATION SUPPLIED.
Each Joy Stick is supplied with a test routine that allows you to draw pictures on your VDU step routines to write your own games, plus one free game on cassette.

1 JOY STICK £14.90 1 PAIR JOYSTICKS £28.90

The Nascom software users book is being compiled; if you would like your program included, please send with a SAE and in return you will get a copy of the book when it is completed.

Bug Monitor for Nascom users - Well worth the money. **£23.40**
Send SAE for details.

Introducing the personal computer you've waited for. THE EXIDY SORCERER.

SEE INSIDE BACK COVER OF THIS MAGAZINE

VIDEO GAMES & Components

UHF Vision modulator Standard channel 36 **2.90**
VHF Vision modulator channel 3 **3.10**
Sound modulator compatible with above **2.90**

AY-3-8500 6 Games **4.90** PCB **1.90**
AY-3-8610 10 Games **5.90** PCB **1.90**
AY-3-8603 Road Race **5.90**

SPECIAL FOR CHRISTMAS

STOCK CLEARANCE

READY TO GO

4 EXCITING NEW GAMES

~~£27.90~~ **£19.90**

complete with power supply

8500 6 game colour basic kit
reduced from **£16.90** to **£7.90**

ETI Tank colour add on **-£5.90**

8610 10 game chip + PCB - £6.50

JOYSTICKS - £1.90 each Dual 200K lin



DIL SOCKETS

PRICES FOR
PACKS OF 10

8 pin 50p
14, 16, or 18 pin **£1.00** 22, 24, 28, or 40 pin **£1.50**

COMPUTER COMPONENTS

A selection of our Computer components

CPU AND SUPPORT DEVICES

Z80	cpu	14.90
Z80A	cpu	19.90
Z80	PIO	9.90
Z80	CTC	9.90
8080A	cpu	5.90
8212	8 Bit I/O Port	1.90
8214	Priority Interrupt Control	4.90
8216	Bi-Directional Bus Driver	1.90
8224	Clock Generator & Driver (2MHz)	2.50
8224-4	Clock Generator & Driver (4MHz)	7.90
8226	Inverting Bi-Directional Bus Driver	3.90
8228	System Controller & Bus Driver	3.90
8238	System Controller & Bus Driver	5.90
8251	Programmable Communication Int.	7.90
8253	Programmable Interval Timer	14.90
8255	Programmable Peripheral Int.	10.90
8257	Prog. Direct Mem. Access Cont.	14.90
8259	Programmable Interrupt Cont.	17.90
6800	cpu	11.90
6810P	128 x 8 Static Ram (450ns)	4.95
68B10P	128 x 8 Static Ram (250ns)	6.00
6820P	Peripheral Interface Adaptor	7.50
6821P	Peripheral Interface Adaptor	7.50
6828P	Priority Interrupt Controller	11.25
6834P	512 x 8 Bit Erasable Prom. 500	16.95
6850P	Asynchronous Comm. Adaptor	9.75
6825P	Synchronous Serial Data Adaptor	11.75
6860P	0-600 RPS Modem	10.00
6862P	2400 RPS Modulator	14.50
6871P	Clock	28.00
6875P	Clock	8.75
6880P	MPU Bidir. Bus Ext.	2.50

MEMORIES

8x 21L02	1K	7.50
21L02	1K	1.00
2101	1K	2.95
2111	1K	3.95
2112	1K	2.95
2114	4K	6.90
4027		2.10
4116	16K	11.90
8x 4116	16K	90.00
2708	1K	7.50
2708	(NASBUG)	9.90
2716	(5V, INTEL)	29.00

OTHER

USEFUL DEVICES

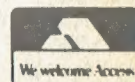
6576	char gen	8.90
6402	UART	9.90
1771	Floppy disk controller	24.90

Full selection of US and British Magazines and books for the Computer Hobbyist.

Prices always changing (usually downwards)
Phone with your requirements



All prices include VAT except where shown. Orders over £5 post and packing free otherwise add 20p. Please make cheques and postal orders payable to COMP, or phone your order quoting BARCLAYCARD or ACCESS number.



COMP COMPUTER COMPONENTS

14 STATION ROAD · NEW BARNET · HERTFORDSHIRE · Tel: -01-441 2922 (Sales)
CLOSE TO NEW BARNET BR STATION - MOORGATE LINE **01-449 6596**
OPEN - 10am to 7pm - Monday to Saturday